# A STUDY OF THE DETERMINANTS OF FACTOR DEMAND BY INDUSTRY

by

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# ABSTRACT

Title of Dissertation: A Study of the Determinants of Factor Demand
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Recent theoretical work in duality theory has lead to functional forms for production and cost functions which easily accommodate more than two inputs yet allow for a multitude of substitution possibilities among the various inputs.

A parallel program of research has led to the view that adjustment of inputs in production to their "desired" levels are interrelated and that this interrelatedness must be incorporated into empirical models of factor demand in order to identify properly the dynamics of factor demand over time.

Finally, empirical work on factor demand has uniformly assumed a geometrically declining pattern of depreciation of capital, thus implying that depreciation and, hence, replacement investment is a constant proportion of the capital stock.

This thesis incorporates the first two lines of research in a study of investment and productivity while, at the same time, improving on the assumption of a geometrically declining depreciation pattern. A factor demand mode is derived which consists of two equations: one for investment and one for labor employment per unit of output. It is applied to each of 53 separate industries which cover the U.S. economy. The variables used to explain factor demand are, basically, relative input prices and movements in industry demand. The prices which appear

in the model are capital costs, labor costs, and energy prices.

There are a number of features of the model which distinguish it from other published works. First, factor demand is studied at a much greater level of disaggregation than in other studies. Second, a simple generalization of the Diewert cost function is used rather than the highly popular translog form. I know of only two other published studies in which the Diewert function is used for empirical work. Third, an investment equation is derived and estimated jointly with a labor requirements equation. In contrast, published studies estimate "capital demand" equations in conjunction with employment equations and possibly other equations, and should be viewed as suspect both because of the difficulties of measuring "capital" and because of the trended nature of any capital stock series. The approach of this study places far greater demands upon the model derived: fitting investment data is far more taxing that fitting capital data. Fourth, the model both minimizes the dependence of its results on a prior measure of capital and incorporates a simple extension of the geometric pattern of depreciaton which allows "reasonable" and varied depreciation patterns across industries. Finally, the model is, essentially, a forecasting tool which is part of a new and highly disaggregated macro model developed by INFORUM. With this in mind, careful attention is given to the long run properties of the model. Consequently, an extensive regime of "priors" are introduced into the estimation process to assure conformity with firmly established findings of past work. What suffers in this effort is the ability of the model to fit historical industry data on investment and productivity and its ability to generate "reasonable" magnitudes for crucial elasticities. It is with an eye to the fits and elasticities that we judge the usefulness of the model for the purposes for which it is intended. Consequently, there is no pretense that we are estimating "unbiased" coefficients. The claims of the model are based upon its ability to fit historical data by equations consistent with our prior view of at least some of the features of the structure of production at the industry level.

Long term forecasts through 1983 of investment and productivity are then made within the context of the macro model previously mentioned. Assessment of the forecasting performance of the equations is based upon a comparison of the forecast results with actual employment and constructed investment through 1981.

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# Chapter 1

# Overview of Study

## 1. Introduction

The Interindustry Forecasting Project of the University of Maryland (INFORUM) has had as its task the design, construction and utilization of a long-term input-output forecasting model of the U.S. economy. The model embodies a high degree of disaggregation by distinguishing outputs for 190 products, equipment purchases by 90 industries, and the purchase of structures by 30 types. The input-output component of the model allows one to forecast, in addition, the sales of each of the 190 products which go into other products as material inputs, as capital goods, consumer demand, exports, inventory change, or government demand.

In addition, there exists a wage-price submodel developed by David Belzer which endogenizes prices and wages within the INFORUM model so that prices not only determine but are also determined by real side activity.

The area of interest of this study is the investment-productivity submodel of the larger INFORUM model. The submodel possessed a number of inadequacies which rendered it unable to answer many important questions. The next section presents an overview of the investment-productivity submodel as it stood prior to completion of this study and an outline of its basic shortcomings.[1] The third section presents a short description of the model which has resulted from this study and a brief summary of the plan of the study.

## 2. Previous Investment and Productivity in INFORUM

The investment-productivity component of the INFORUM model included some features of neoclassical production theory as well as ad hoc equation specifications for productivity. There were investment equations for 87 industries and productivity equations for 100 industries. The functional form and behavioral assumptions for the investment equations were identical for all industries. That is, "desired" capital stock equations were derived, based upon profit maximizing behavior by the firm and the use of the CES production function. The basic equilibrium condition is that the firm demands capital up to the point where the marginal cost of the equipment, c, equals the value of the marginal product of capital:

$$c = P * \partial Q/\partial K \qquad (1)$$

where P is the price of output, Q, and K is the capital stock. For the CES production function, the marginal product of capital is given by

$$\partial Q/\partial K = \beta * (K/Q)^{\sigma} \qquad (2)$$

where $\beta$ is a scalar, $\sigma$ is the elasticity of substitution. Substituting (2) into (1) gives the relationship between "desired" capital, $K^*$, output, and the "relative user cost of capital", $r = c/P$,

$$K^* = \alpha Q r^{-\sigma} \qquad (3)$$

where $\alpha = 1/\beta$

Equation (3) will hold only in equilibrium. At any time t, however, actual capital will depend upon present and lagged values of output and the relative user cost of capital. Consequently, (3) should be rewritten as

$$K_t = \prod_i Q^{w_i} r^{v_i}$$

where $w_i = 1$ and $v_i = -\sigma$. Taking natural logs, first differencing, and multiplying both sides by $K_{t-1}$ gives the net investment equation:

$$N_t = K_{t-1} \sum_i w_i \underline{\Delta} Q_{t-i} + K_{t-1} \sum_i v_i \underline{\Delta} r_{t-i} \tag{4}$$

where $\underline{\Delta} Q_t = (Q_t - Q_{t-1})/Q_{t-1}$ and $\underline{\Delta} r_t$ is defined similarly. The only step now left before one may actually estimate (4) is to construct the dependent variable, net investment. There exists data constructed by the INFORUM project on average tax lives for equipment by industry and varying from year to year. With some modifications, these lives were assumed to be the average service lives for equipment. Then, with the use of these data, capital stocks were constructed as follows:

$$K(t) = B_1(t) + B_2(t) \tag{5}$$

where

$$B_1(t) = I_t + (1-d_t)*B_1(t-1)$$

$$B_2(t) = d_t*B_1(t-1) + (1-d_t)*B_2(t-1).$$

I(t) is gross investment at time t, $L_t$ is the average service life of capital, and $d_t = 2/L_t$. Then replacement investment is given by

$$R_t = d_t*B_2(t-1) \tag{6}$$

and net investment, the dependent variable in (4), is given by

$$N_t = I_t - R_t$$

The method of contructing capital in (5) represents an improvement upon the geometrically declining depreciation pattern used throughout the literature. The implied depreciation pattern allows replacement to be low early in the equipment's life, with depreciation increasing as the equipment grows older. Consequently, (5) gives depreciation patterns which were thought more "reasonable" than the geometric pattern used by other researchers. However, a shortcoming of this earlier model was that the depreciation pattern given by (6) was imposed upon all industries.

The productivity equations were simply log linear relationships with the log of employment per unit of output as the dependent variable and some combination of an exponential time trend, log of output, the change in the log of output, and a lag dependent variable as the independent variables. Attempts were made to introduce measures of capital into the productivity equations without success. To my knowledge, no attempt was made to derive and estimate an employment equation based upon the CES production function.

The links between capital formation and productivity growth, consequently, were at best indirect and lacked theoretical foundation. A change in productivity, other than its trend, could only occur as a (still in model) result of a change in industry demand. Productivity growth was unaffected by the technological relationship between capital and labor in production as implied by the investment equations.

Thus, the first serious shortcoming of the investment-productivity submodel was the complete lack of direct interdependence between capital formation and productivity growth. Indeed, the long run growth in average labor productivity was virtually insensitive to economic activity, being determined, almost entirely, by a time trend.

Because of the lack of interdependence as well as theoretical underpinning, the INFORUM model could not be used to study the response of productivity growth to, say, tax policies designed to stimulate investment. Especially in a time of great debate about the causes and cures of the productivity slide of the 1970's, this shortcoming caused considerable uneasiness. A long term model should have the capability of providing forecasts which are useful in answering long term public policy questions.

Capital formation is not the only determinant of productivity growth, nor are changes in output, capital costs, and labor costs the only determinants of investment behavior. On the productivity side, there are clear signs of cyclical productivity movement which appear to be counter to theore~~p~~tical expectations within the framework of a two factor production function. Consequently, business cycle variables, such as the percentage change in demand, may have an important short run effect upon productivity movement. In addition, both the demand and price of energy may have a significant direct effect upon both productivity and investment decisions by the firm. If one properly views energy as an additional input in production, then, since under optimizing behavior factor demand depends upon relative costs, changing energy prices would lead to changes in investment and employment, even in the presence of unchanged demand and unchanged capital and labor costs. Thus, the second shortcoming of the early investment-productivity submodel was its inability to accommodate flexibly other inputs and input prices into the neoclassical framework. As is well known, an attempt to extend the CES production function to more than two inputs leads to the requirement that the elasticity of substitution among the various inputs be identical.

A third shortcoming in the existing investment equation may be found in the method of determining replacement investment by industry. As mentioned earlier, the pattern of depreciation assumed by the earlier model was perhaps more realistic than the geometrically declining pattern often utilized. However, the obvious question to raise is Why must all industries possess the same depreciation pattern? It would be both appropriate and more desirable to introduce a method of estimating replacement investment which would permit average service lives to differ not only by industry, but also over time, and to have different patterns of depreciation. One industry may purchase equipment in which most of its depreciation occurs early in its life, so that the geometric pattern may be the most accurate approximation of depreciation for that industry. An example might be the purchase of automobiles by a car rental agency. On the other hand, another industry may purchase equipment which depreciates little early in its life, and begins to lose productive efficiency rapidly only after some period of time. An example might be the purchase of taxi cabs by a cab company. The geometric pattern would, consequently, not be an accurate representation of equipment depreciation for this industry.

This study's goal is to replace the model just described with one which corrects its inadequacies.

## 3. The New Investment-Productivity Model

The investment and employment model derived in the following chapters is firmly ensconced in the received neoclassical theory of production. The behavioral assumption is that firms seek to minimize the cost of production subject to exogeneous demand and a vector of input prices. To allow for the effects of energy prices and other factors on capital and labor demand, the generalized Leontief Cost Function (GLF) is used. For a subset of possible parameter estimates, the GLF may be viewed as a second order approximation to an arbitrary, continuous, concave cost function which results from cost minimizing behavior by the firm. The function is "flexible" because it imposes no *a priori* constraints upon the elasticity of substitution among the various inputs. Consequently, it permits a variety of substitution possibilities among the various inputs.

Shephard's lemma allows one to derive the factor demand equations for each of the inputs. In this study, equations for capital, production workers, nonproduction workers, and energy are derived. From these essentially equilibrium relationships, we construct actual factor demands. From the capital demand equation, we derive a net investment equation. The crucial link between investment and labor employment will be the capital-labor relative price. Moreover, common parameters appear in both the investment equation and the employment equations.

The changes in investment and employment result from movements in relative prices and demand. We do not view the inter-relationship as one in which changes in investment lead to changes in productivity. Our model hypothesizes that it is changes in relative prices which lead simultaneously to changes in capital-output ratios and labor productivity. Consequently, neither investment nor measures of capital appear in the productivity equation.

In order to explain gross investment, we need an expression for replacement investment as well as net investment. The method developed in this study is a generalization of the approach mentioned in section 2, which allows patterns of depreciation to differ across industries. Replacement is given by the expression

$$R_t = \{d_1 f(L) + d_2 f(L)^2 + d_3 f(L)^3\} * I_t$$

where the d's are determined during the estimation of the model and are required to sum to unity, $f(L) = (1-\lambda)/(1-\lambda L)$ where L is the lag operator, and $\lambda$ is determined by the average service life of equipment for that industry.

The model which is derived consists of four equations- equipment investment, demand for production workers, demand for nonproduction workers, and energy demand- while the model actually estimated consists of only an investment equation and a total labor requirements equation. Data limitations prevented the estimation of the full four equation model. However, industry specific energy prices are introduced into the model and play a significant role in explaining investment and productivity by industry. The dynamics of investment and productivity are closely related. Consequently, care is taken that the distributed lag structures on the independent variables in the respective equations are consistent with the underlying production function.

There are two distinguishing features of this study which represent departures from much recent empirical work in factor demand. First, all dependent variables in this model are actually observed. In contrast the latest published studies usually include dependent variables which must be constructed. Typically, the dependent variables depend upon some measure of the capital stock and the user cost of capital, neither of which are observed. As a corollary to this first feature, we have earnestly tried to minimize the dependence of the empirical results upon a prior measure of capital. This desire has lead us to avoid a popular procedure of introducing measures of capital into the productivity equation as an explainer of dynamic behavior.

Second, the purpose of the model presented in this study is to forecast annual movements in investment and productivity up to 15 years into the future. To accomplish this, the model is embedded within a new 72 sector input-output model designed by members of the INFORUM project.[2] This new model includes many important macro features which the older INFORUM model did not have. Consequently, greater structure in imposed upon the investment-productivity submodel than is required by the production function alone, so that forecasts we deem reasonable are generated. Specifically, own price elasticities are not allowed to be positive, and capital and labor are not permitted to be complements. ?? The first condition is most crucial both because the weight of empirical evidence supports it, and because should the condition be violated, the model would give forecasts which, in our view, would be indefensible. The second condition is not as crucial, yet was imposed because there is considerable empirical evidence supporting it. ?

The plan of the study is as follows: Chapter 2 presents a selected review of the relevant literature. In Chapter 3, we derive the model itself, while in Chapter 4, we discuss the construction of the data. Chapter 5 presents a discussion and defense of the method of estimating the model, an overview of the industry time series on productivity and capital growth, and relative price movement, and the empirical results of estimating the model. Finally, Chapter 6 presents simulation results by comparing "actual" investment and employment through 1983 with those predicted by the model.

## FOOTNOTES

1. See Almon et.al. in (2) for a complete description of the INFORUM model.

2. See Almon (1) for a description of a preliminary version of the LIFT model.

# REFERENCES

1. Almon, Clopper, "LIFT -- Chase's New Long-Term Interindustry Forecasting Tool," *U.S. Macroeconomic Forecasts and Analysis*, Chase Econometric Associates, Inc., August 1981, pp. A-1 - A-15.

2. Almon, C., Buckler, M., Horwitz, L., and Reimbold, T., *1985 Interindustry Forecasts of the American Economy*, Lexington, Mass.: D.C. Heath, 1974.

# Chapter 2

# Survey of the Literature

## 1. Introduction

This chapter contains a discussion of some of the recent developments , both theoretical and empirical, which have preceded and given rise to the present study. The discussion of past investment work will emphasize developments since the appearance of Jorgenson's survey article on investment behavior (23) in 1970. A brief review of the earlier work is mentioned insofar as that work remains relevant and useful today.

A review of econometric work on employment behavior has recently been published by Hamermesh (20). My comments in this area will, consequently, be brief. I will concentrate mainly on the salient features of his article which are relevant to the present study.

In the next section, there is a brief summary of the econometric work on investment behavior reviewed by Jorgenson and important to this work. In section 3, there is a review of the employment literature with special emphasis upon the empirical findings on the sensitivity of labor demand to various input prices. Section 4 contains a review of the empirical work after 1970 and a discussion of the major theoretical developments in factor demand analysis. In addition, there is a review of a number of empirical studies which have made use of this theory. In the concluding section, there is a brief critique of the past work with a view to those areas which this study is especially designed to address.

## 2. Investment Work to 1970

There were three developments of this period upon which this study has heavily relied. The first was the formulation of numerous methods for reparameterizing distributed lag functions for theoretical desirability and computational simplicity. As surveyed by Griliches (16), these methods permitted the researcher to impose what he believed were reasonable patterns upon the distributed lags without directly constraining the parameters themselves. During these years, the geometric distributed lag function was the most popular among researchers, although others were employed.[1]

The second development was the decision to view investment behavior in two stages. In the first stage, an expression was either derived or assumed which explained the "desired" capital stock. The "desired" stock is defined as the long run equilibrium amount of capital employed if all determinants of capital, usually output and relative prices, remained unchanged from their initial values. From the desired capital relationship, one may then readily derive a "desired" net investment equation by taking derivatives of both sides and approximating the time derivative of desired capital with the first difference in the desired stock of capital; i.e., desired net investment. In the second stage, one sought a specification for the time structure of _actual_ net investment by assuming, deriving or imposing upon the desired net investment expression a distributed lag function, selected from the many reviewed by Griliches. The distributed lag would relate actual net investment to present and past changes in desired net investment. From such a relationship, the researcher could trace out the actual path over time of investment induced by a one-time change in one of the independent variables.

The third development, as Jorgenson points out, was the distinction between net investment, i.e., investment aimed at increasing the capital stock, and replacement investment, which results from the fact that equipment depreciates over time. As a consequence, some investment would be necessary merely to maintain the capital stock. Most researchers assumed that replacement was a constant proportion of the capital stock, suggesting that the underlying mortality distribution for investment goods was geometric.[2]

Much of the debate of this period was over the determinants of the desired capital stock,[3] while the distributed lag pattern for actual net investment was simply a matter of choosing the pattern which provided the best fit. In addition, most studies were done at a very aggregate level[4] using quarterly data. Finally, none of the researchers who assumed a neoclassical production function seemed concerned about or interested in the properties of the employment equation implied by the parameter estimates in the investment equation.

## 3. Econometric Work on Employment

The studies on labor employment have primarily dealt with and answered questions related to the short run behavior of labor demand. As Hamermesh states, there is a considerable aggreement among the studies about the short run (one year) elasticity of labor with respect to its own price, approximately -.15, and output, approximately .75.

Hamermesh divides the labor demand studies into three categories. The first are those which employ the marginal productivity condition of labor. This means nothing more than formulating a labor demand equation as a function of output and the wage rate. The second type includes those studies which introduce the user cost of capital into the equations in addition to the wage rate. The third type is the "interrelated factor demand and adjustment" approach which integrate the employment equation within an overall factor demand model which includes at least an investment equation and possibly other input demand equations. This third group of studies, within which this work belongs, will be discussed more fully in the next section.

There seems to be no significant discord among the studies within the first two categories, as stated above. As far as the present investigation is concerned, the major importance of these earlier works is that the assumption of constant returns to scale which is made in the next chapter is not completely unreasonable.

## 4.Recent Work on Factor Demand

A number of major criticisms have been directed at Jorgenson's work.[5] Partly as a consequence, in the past 10 years there have been important improvements in two of the pre-1970 developments discussed in section 2. First, researchers have explicitely recognized that the adjustment patterns of different inputs in production might be interrelated. This recognition has led to a generalization of the distributed lag models used earlier in investment studies by Jorgenson and others. The second development, and most important for this study, is the proliferation of new, more flexible functional forms for both production and cost functions which, in turn, have lead to factor demand models capable of asking and answering more questions. Each of these developments will be discussed in turn.

## Factor Demand Models with Interrelated Dynamic Behavior

A number of researchers have extended the theoretical work on adjustment costs begun by Eisner and Strotz (13) and Holt, Modigliani and Simon (22). As a result, optimizing models of the firm have been derived which explicit~~e~~ly take account of the adjustment costs of changing the levels of various inputs.[6] In addition, these studies have firmly established the interrelatedness of the adjustment patterns of the different inputs, suggesting that distributed lag specifications must be consistent across factor demand equations and with the underlying production function.

Nadiri and Rosen (31) undertook the most extensive early econometric application of these new theoretical models. They specify a seven-factor[7] Cobb-Douglas production function and solve for the static cost minimizing factor demand equations given input prices and output:

$$Y^* = B*Q + A*R \tag{1}$$

where $Y^*$ is a column vector of logarithms of desired inputs, Q is the logarithm of output, R is a column vector of logarithms of input prices, and B and A are a column vector and matrix of coefficients, respectively. They then impose upon this static model a log linear adjustment system

$$Y_{it} - Y_{it-1} = \sum_{j=1}^{7} C_{ij}*(Y_{jt}^{*} - Y_{jt-1}) + e_{it} \qquad (2)$$

where $Y_{jt}^{*}$ is the desired (log of) input j at time t, $Y_{jt}$ is actual log of input j at time t, $e_{it}$ is a random, zero mean, constant variance disturbance term, and $C_{ij}$ is a fixed adjustment coefficient relating the demand for the ith input to a divergence from equilibrium of the demand for the jth input. Equations (1) and (2), combined with certain restrictions on the adjustment matrix in order that it remain consistent with the production function,[8] then lead to a system of factor demand equations which are estimated both at the manufacturing level and at the two-digit SIC level.

The Nadiri-Rosen study should be viewed as an important contribution to econometric work on factor demand because it attempted for the first time to estimate a complete system of factor demand equations which generated dynamic behavior for all inputs consistent with the underlying production function. An important shortcoming of the model, however, is its use of the Cobb-Douglas production function. This deficiency may now be corrected thanks to the development of new functional forms for production and cost functions.[9]

## Duality Theory of Cost and Production Functions

The development of new functional forms for factor demand analysis was a direct result of the Duality Theory of cost and productions functions. The word "duality" here refers to the fact that, from any n factor production function satisfying certain regularity conditions (discussed below), we may derive a "dual" minimum total cost function under the assumption of minimizing behavior and, conversely -- or better, "dually"--, from a given minimum total cost function satisfying approximately the same regularity conditions, the "dual" production function may be derived, again under the assumption of minimizing behavior. The new production function may, in turn, be used to derive the original cost function. Consequently, for any "well behaved" production function there exists a "well behaved" cost function, and vice versa. This result has been very important for those interested in the determinants of demand for factors of production. For, it has also been shown that a very simple relationship exists between minimum total cost functions and factor demand equations.

The theory of duality begins with the definition of the production function. Define F(x) as the maximum output which may be produced given input bundle $x = \{x_1,\ldots,x_n\}$. Label the $i^{th}$ bundle as $x^i = \{x_1^i,\ldots x_n^i\}$. In addition, $x^i >= x^j$ will mean that each component of the bundle $x_i$ is at least as large as the corresponding component in bundle $x_j$. By $\Omega$ we mean the non-negative orthant in n dimensional Euclidian space; and Q represents output.

Assume that the production function satisfies the following regularity conditions:[10]

(a) F is a real valued function of n real variables, and F is finite for finite x.

(b) $F(0) = 0$ and for $x^i >= x^j$, $F(x^i) >= F(x^j)$.

(c) For any positive integer N, there exists a vector, say $x^N$, such that $F(x^N) >= N$.

(d) F is continuous.

(e) F is a quasiconcave function over $\Omega$ ; i.e., the set $L(Q) = \{x: F(x) >= Q, x \varepsilon \Omega \}$ is a convex set for $Q > 0$.

Conditions (a), (b) and (d) impose the intuitively compelling properties that the production function be real valued, non-decreasing and continuous, respectively. Condition (c) means that any positive output may be produced by some input combination, while condition (e) is a generalization of the neoclassical condition that F be concave, i.e., F exhibits diminishing returns with respect to any one input. Diewert (12) showed that the concept of quasi-concavity is a generalization of the notion of concavity.

Now, define the production possibility set for a given output Q as

$$L(Q) = \{x: F(x) >= Q, x >= 0\}.$$

The production possibility set is, therefore, the set of input bundles which can be used to produce at least a given level of output, Q. The set is a function only of Q, for by varying output the set of inputs which may at least produce that level of output will vary. Diewert (12) showed that conditions (a) through (e) on production functions imply the following conditions on the production possibility set:

(a') $L(0) = \Omega$ , the set of all possible input bundles.

(b') For every $Q >= 0$, $L(Q)$ is a convex set.

(c') If $x^i >= x^j$ and $x^i \varepsilon L(Q)$ then $x^j \varepsilon L(Q)$.

(d') If $Q_1 >= Q_2$ then $L(Q_1)$ is a subset of $L(Q_2)$.

(e') For every $x \varepsilon \Omega$ , there exists a Q such that $x \varepsilon L(Q)$.

(f') G is closed where $G = \{(Q;x): x \varepsilon L(Q), x >= 0, y >= 0\}$.

Finally, given a family of production possibility sets, L(Q), satisfying conditions (a') through (f'), the function

$$F^*(x) = \max_{Q>0} \{Q: x \varepsilon L(Q)\}$$

itself satisfies conditions (a) through (e). In addition, the family of production possibility sets generated by $F^*(x)$, namely, $L^*(Q)$, coincides with the original family of production possibility sets L(Q).

The discussion above reveals that there exists a correspondence between production functions which satisfy certain conditions and production possibility sets which satisfy certain conditions. A similiar correspondence exists between production possibility sets and cost functions.

Suppose we have a production function of n inputs generating a single output. Assume this production function satisfies conditions (a) through (e). Then the production possibility set, L(Q), generated by this production function must satisfy condition (a') through (f'). Now, assume the producer wishes to minimize the cost of producing a fixed output, Q. Then we may define the producer's minimum total cost function as

$$C(Q;p) = \min_{x} \{p^T x : x \in L(Q)\} \text{ for } p > 0 \tag{3}$$

where p is a vector of input prices. Diewert (12) has shown that the cost function defined by (3) ,where L(Q) satisfies (a') through (f'), must satisfy the following conditions:

(a") $C(Q;p)$ is a positive real valued function defined and finite for all finite $Q > 0$ and $p > 0$.

(b") $C(Q;p)$ is a nondecreasing left continuous function in Q such that $\lim_{Q\to\infty} C(Q;p) = \infty$.

(c") $C(Q;p)$ is a nondecreasing function in p.

(d") $C(Q;p)$ is linearly homogeneous in p.

(e") $C(Q;p)$ is a concave function in p.

Now, using this cost function, which is defined given a production possibility set, we may generate a new family of production possibility sets, $L^*(Q)$. This new family is written as

$$L^*(0) = \Omega$$
$$L^*(Q) = \{x: p^T x >= C(Q;p) \text{ for every } p > 0 \text{ and } x >= 0\}.$$

Diewert has shown that this new production possibility set will satisfy conditions (a') through (f'). In addition, if the original set, L, satisfies conditions (a') through (f'), then L will be identical to $L^*$. The importance of this proposition is obvious. If a properly behaved production possibility set is derivable from a cost function satisfying conditions (a") to (e"), and if a correspondence exists between these sets and the underlying production function, then the cost function is all that is needed to analyze the structure of production.

Finally, if the cost function C(Q;p) satisfies conditions (a") through (e"), and is differentiable with respect to factor prices, then according to Shephard's Lemma

$$\partial C/\partial P_i = X_i$$

where $X_i$ is the cost minimizing bundle of input $x_i$ needed to produce output Q given factor prices p.

Duality theory, therefore, allows one readily to ascertain factor demand functions which are the result of optimizing behavior by the firm. In fact, all we need do is find a function which satisfies conditions (a") to (e"), and we know that we have a cost function which is derivable from cost minimizing behavior by the firm. Even though we know that the function comes from a "well behaved" production function, embodied within the definition of $L^*(Q)$, we would never need to "look at" the underlying production function. The cost function supplies us with all the information we need.

As a result of the Duality Theory just described, a number of functional forms have become available to researchers and have been utilized in empirical work. I will discuss two such functions, although others may be found in the literature.

Translog Cost Function

Christensen,Jorgenson and Lau (9) have proposed the following cost function:

$$\ln C = a_0 + \sum_i a_i \ln P_i + (1/2)\sum_i \sum_j b_{ij} \ln P_i \ln P_j + a_Q \ln Q + \sum_i b_{iQ} \ln P_i \ln Q \tag{4}$$

where Q and P are observed output and input prices, C is the minimum total cost and $b_{ij} = b_{ji}$. The symmetry constraint on the $b_{ij}$'s gives partial derivatives of the budget shares which are symmetric. The main advantage of this functional form, as with the one discussed below, is that it is a second order approximation of an arbitrary twice-differentiable cost function[11] which does not place a priori restrictions on the Allen partial elasticities of substitution (AES).[12] In particular, if $b_{ij} = 0$ for all i,j, then the cost function reduces to the dual of the Cobb-Douglas production function. In addition, (4) may be used to test returns to scale econometrically. Constant returns to scale would be supported should $a_Q = 1$ and $b_{iQ} = 0$ for all i. Finally, if $\sum_i b_{ij} = \sum_j b_{ji} = 0$ and $\sum_i a_i = 1$, the function exhibits linear homogeneity in input prices.

To use econometrically, take log derivatives of both sides of (4):

$$\partial \ln C/\partial \ln P_i = a_i + \sum_j b_{ij} \ln P_j + b_{iQ} \ln Q$$

Since $\partial \ln C/\partial \ln P_i = (\partial C/\partial P_i)*(P_i/C)$ and $\partial C/\partial P_i = X_i$ by Shephard's Lemma, where $X_i$ is the cost minimizing demand for the ith input, the left side of the above equation is $P_iX_i/C$, which is the budget share of the ith input, $S_i$. Thus

$$S_i = a_i + \sum_j b_{ij} \ln P_j + b_{iQ} \ln Q. \tag{5}$$

Now, since all the variables in (5) are observable, the parameters may be estimated and elasticities and returns to scale may be determined.

There have been numerous studies which have made use of the translog functional form. They may be distinguished by the type of questions that they address.

The first group of studies are those which test the separability properties of the underlying technology. Berndt and Christensen (4) showed that a necessary and sufficient condition for weak separability to exist with respect to a partition of inputs is certain equality restrictions on the AES.[13] In (5), they test the hypothesis that blue collar and white collar workers are weakly separable from capital. The hypothesis is accepted if the AES between blue collar workers and capital is not significantly different from the AES between white collar workers and capital. Their conclusion is that the hypothesis must be rejected, which in turn implies that there is no way to construct a consistent aggregate index of blue and white collar workers in U.S. manufacturing. Berndt reports in a separate study (3) that structures and equipment are not separable from labor. From this, he concludes that structures and equipment should be studied in a disaggregated framework.

A second group of studies were designed to investigate the relationship between capital and various kinds of energy inputs. These studies have generated an active debate in the literature about the capital-energy relation since the nature of this relationship leads to divergent implications for government policies. The disagreement has come down to whether capital and energy are complements or substitutes in production. Berndt and Wood (6) found evidence of capital-energy complementarity using time series data from 1947 to 1971 for all manufacturing. In addition, their elasticity measure was extremely high, above 3.0 in absolute value, suggesting that capital is very sensitive to changes in energy prices. On the other hand, James Griffin and Paul Gregory (17) and Robert Pindyck (32) report energy-capital substitutability. Berndt and Wood in (7) attempt to reconcile these divergent findings.

A third group of studies use the translog functional form as an aggregation formula for an index of aggregate inputs. Diewert showed that the translog functional form provides a *superlative* index number formula for the translog production function. As applied by May and Denny (26), one may use the aggregation formula provided by the translog function to generate an aggregate index of inputs which will, in turn, lead to proper measures of total factor productivity. May and Denny go on to show that further modification of the production function allows one to begin to disintangle the various kinds of technical change that may occur in production.

There is one published example of a study which seeks to combine the translog cost function with a model of dynamic behavior. Mohr (29) combined the cost function with a generalized stock adjustment model which he hypothesized could adequately represent the dynamic behavior of the cost shares. More is said about this study below.

Generalized Leontief Cost Function

Diewert (12) proposed the following cost function:

$$C = h(Q) \sum_{i}\sum_{j} b_{ij} P_i^{.5} P_j^{.5}$$

where h is continuous, monotonic in Q, and h(0) = 0; and B = $(b_{ij})$ is a symmetric n by n matrix with non-negative elements. It is easily shown that under these conditions, C satisfies conditions (a") through (e") above.[14] However, the non-negativity of B places severe restrictions upon the parameter estimates of the cost function. This may be seen by computing the ijth AES using the relationship between the cost function and the elasticity first established by Uzawa:[15]

$$ES_{ij} = .5*C*h(Q)*b_{ij}P_j^{-.5}P_i^{-.5}/X_iX_j$$

In the case where all $b_{ij}$'s are positive, all factors in production are substitutes in the production process. But, as was mentioned earlier, it is entirely possible when dealing with more than two factors of production that some inputs are actually complements. Thus, it will be desirable to allow, at least initially, unconstrained signs on the $b_{ij}$'s, suggesting the possibility of complementarity among some pairs of inputs. Therefore, if the $b_{ij}$'s were to be estimated econometrically, and some were found to be negative, the researcher would then have to check for the concavity of C given historical prices, as well as the monotonicity of C given factor prices.[16]

Assuming h(Q) = Q and applying Shepard's Lemma gives factor demand equations which are linear in the square root of relative prices:

$$X_i = Q \sum_j b_{ij} (P_j/P_i)^{.5}$$

One may then estimate the factor demand system using conventional econometric techniques, and be capable of answering many questions about the structure of technology.

The GLF may easily be extended to incorporate non-price variables that might affect factor demand.[17] Let p be a n x 1 vector of input prices and Z a m x 1 vector of other yet to be specified variables. Then the revised GLF (RGLF) may be written as

$$C(Q,P,Z^*) = Q*P^{.5^T}BP^{.5} + .5*Z^{*^T}AZ^*$$

where B is described above and A is an (n+m) by (n+m) symmetric matrix, and $Z^{*^T} = (Z^T;P^T)$. We will require $a_{ij} = 0$ for all $P_i$ and $P_j$ where $P_i$ refers to the i^th input price. Then the Hessian of the revised GLF reduces to that of the GLF above. This may be seen if we write the latter part of the RGLF in partitioned form. So let $A=\begin{bmatrix} A_1 & A_2 \\ A_3 & 0 \end{bmatrix}$ where $A_1$ is an m x n symmetric matrix, $A_2 = A_3^T = A^*$, and 0 is an n x n matrix of zeros. Then (7) becomes

$$\begin{aligned} C(Q,P,Z^*) &= Q*P^{.5^T} BP^{.5} + .5*(Z\ ;P\ )^T \begin{bmatrix} A_1 & A_2 \\ A_3 & 0 \end{bmatrix} \begin{pmatrix} Z \\ P \end{pmatrix} \\ &= Q*P^{.5^T} BP^{.5} + .5*Z^T A_1 Z + P^T A^* Z \\ &= C(Q,P,Z) \end{aligned}$$

The Hessian of this cost function, then, becomes exactly identical to the Hessian of the GLF, namely

$$\partial^2 C/\partial P_i \partial P_j = \begin{cases} -.5*Q*\sum_j b_{ij} P_i^{-1.5} P_j^{\ .5} & i = j \\ .5*Q*b_{ij} P_i^{-.5} P_j^{-.5} & i \neq j \end{cases}$$

Therefore, concavity of the RGLF depends entirely upon the matrix B. If all $b_{ij}$'s are positive, implying that all inputs are substitutes, then concavity follows immediately. If some of the $b_{ij}$'s are negative, then the negative semi-definiteness of B must be tested.

There are two published studies which I am aware of which have made use of the GLF functional form. Almon, Belzer and Taylor in (1) apply the GLF function in an attempt to estimate the energy input per unit of output for 20 two digit manufacturing industries in 48 states using cross section data in 1975. They found a high degree of sensitivity of various energy inputs to their own price. The cross price elasticities indicated substitutibility among the various inputs, an outcome resulting from an estimation procedure which did not allow complementarity between pairs of inputs except in the case of capital and energy.

A second study by Woodland (37) applied the RGLF to annual time series data for ten Canadian industries. The study attempted to measure the relationship between labor, structures and equipment in production in each of these industries. He assumed complete adjustment of inputs in a year. His major findings are that structures and equipment are highly sensitive to their respective own prices while labor is highly unresponsive to its own price.

## 5. Critique and Conclusions

The new functional forms for production and cost functions have been shown to be most useful tools for empirical analysis. However, the empirical works to date which have made use of these functions are not without significant flaws.

When using the translog functional form, the presence of measurement error in the independent variables makes interpreting the results difficult. If, for example, the usercost is subject to serious measurement error uncorrelated with the cost shares, which may not be an unreasonable assumption, then the coefficient estimates on the usercost will be biased towards zero, and the elasticities of substitution will be biased towards 1. Consequently, the lack of correlation between, say, capital's share and its own price may be the result of measurement error in the usercost, rather than resulting from some underlying structure of technology. This problem also exists if one should use the

Diewert function. The measurement error will, in this case, lead to elasticity measures biased towards zero. If one is interested in determining the sensitivity of the demand for an input to a vector of relative prices, it seems more reasonable to try to reject the null hypothesis that the elasticity is zero. Otherwise, one might conclude, using the translog function, that there is indeed significant correlation when in fact there is no evidence to support such a conclusion.

All but one study which have made use of the translog functional form and the one study which has made use of the GLF with time series data have assumed that observed inputs and relative prices represent equilibrium values. This is unquestionably an incorrect assumption, one which contradicts much work on investment behavior over the years. In addition, the translog presents a special difficulty for dynamics. In Mohr's work, the assumption is made that the generalized stock adjustment model may be applied to the cost shares. There are two problems with his approach. First, although theoretical work shows that the stock adjustment model generates a reasonable dynamic structure for factor demand systems, it is not clear that such a model is best for the dynamics of cost shares. For example, one's expectation would be that when the price of an input goes up, the cost share of that input would go up, initially, above its eventual equilibrium value. Thus, one would expect a rather uniform overshooting of cost shares, initially, in response to price changes. Typically, however, the generalized stock adjustment model generates dynamic behavior which shows the dependent variable moving monotonically towards its new equilibrium value, the kind of dynamics which cost shares should not exhibit. Second, the use of the translog in Mohr's work provides information on the dynamics of the cost shares, yet does not give direct information on the dynamics of the input demands. Mohr was interested in distinguishing between the long run demand for factors and the short run cyclical variation. To do this, he had to construct a series which represented the minimum total cost in each year. Although he makes a serious atempt to do so, his method must be looked at with caution. Had the GLF been used, the distinction between short run and long run factor demand could have been readily made.

Finally, no studies to date have attempted to use these new functional forms to estimate investment equations. All studies have estimated only capital demand equations. Thus, their results depend, heavily, upon the method used to construct the capital stock. A more stringent test of a particular cost function would be to derive and estimate an investment equation. The next chapter does just this.

## FOOTNOTES

1. For example, Grunfeld (18), Meyer and Glauber (27), Evans (15), Hickman (21), and Hall and Jorgenson (18) all utilized the geometric distribution lag function. Holt, Modigliani and Simon (22) provided some theoretical justification for such a lag. For other examples, see Jorgenson (23).
2. Virtually all studies surveyed by Jorgenson which attempted to measure capital assumed such a distribution. The popularity of the geometric distribution appears to be due mainly to its mathematical tractability. Klein (24) points out, howvever, that one of the implications of the geometric distribution, that depreciation be a constant proportion of the capital stock, is not supported by survey data.
3. As an example of this debate, see the Eisner (14) and Coen (10) comments on Hall and Jorgenson's paper (19) which made use of the Cobb Douglas (CD) production function to measure the affects of tax policy on investment demand. See Klein (24) for a summary.
4. Among the exceptions were Meyer and Kuh (28) and Almon, S. (2).
5. Brechling (8) briefly reviews the criticisms and offers a few of his own. Also see Klein (24), Eisner (14) and Coen (10). Among the criticisms are: (i) the Cobb Douglas is a much too restrictive function to use for investment work; (ii) the derived equations actually used by Jorgenson are not the factor demand equations implied by the CD production function assuming optimizing behavior by the firm; and (iii) the distributed lag pattern used is without

theoretical justification and inadequately accounts for future expectations of relevant exogeneous variables.

6. See Brechling (8), Treadway (33),(34),(35), Craine (11), Lucas (24) and Mortensen (30).

7. The inputs are: capital, production workers, non-production workers, their respective utilization rates, and inventories.

8. Substituting (1) into (2) gives $Y_t = CBQ+CAR+(I-C)Y_{t-1}$. This expression is entered into the production function, $Q=d'Y$, to give $Q=d'B^*Q+d'A^*R+d'(I- A)Y_{t-1}$ where $B^*=CB$ and $A^*=CA$. The expression is satisfied at all times only in the case where $d'B^* = 1$; $d'Q^* = 0$; and $d'(I- A) = 0$. Thus, we have the additional constraints imposed upon the model.

9. There was, in addition, severe data problems which greatly restricted the model. For example, the model was able to include only one relative price- namely, the price of capital relative to the wage rate.

10. The discussion on duality which follows is taken from Diewert (12).

11. This is true only if the estimated parameters are such that the translog satisfies conditions (a") through (e").

12. The AES for a technology with n inputs is defined as the percentage change in the ijth input ratio in response to a percentage change in the jith relative price, holding output and all other input prices constant. Uzawa (36) showed that the AES may be written, using the cost function, as $ES_{ij} = C\ C_{ij}/C_iC_j$ where the subscripts refer to partial derivatives with respect to input prices. Using the cost function expression for the AES, it may be shown that the AES for the CD is unity; and for the CES, it is constant.

13. A cost function is weakly separable with respect to a partition of inputs, R, if the ratio of marginal products of any two inputs, $X_i$ and $X_j$, from a subset of R, say $N_s$, is independent of the quantities of inputs outside $N_s$. A cost function is strongly separable with respect to the same partition if the ratio of marginal products of $X_i$ from $N_i$ and $X_j$ from $N_j$ is independent of the quantities of inputs outside of $N_i$ and $N_j$.

14. See Diewert (12).

15. See note 12.

16. Concavity may be determine by observing whether the Hessian is negative semi-definite. See Diewert (12) for a discussion.

17. The translog may be extended in like fashion.

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# Chapter 3

# A Model of Factor Demand

## 1. Introduction

In this chapter, a model of factor demand is presented. In section 2, the underlying theoretical assumptions are explained and a system of demand equations is derived. In addition, there is a discussion of the necessary equilibrium properties which imply certain restrictions on the sign patterns and estimated parameters of the model. The elasticity measure used in the latter part of the study is also derived. In section 3, dynamic considerations lead to a modification of the equilibrium model of section 2 by introducing distributed lags in a way which satisfies the production function constraint and leaves invariant the long run properties of the model. In section 4, a method of estimating replacement investment is developed which allows patterns of depreciation to vary among industries, given an assumed maximum allowable average service life. An expression for measuring the capital stock is then derived. One sees that the measure of the stock is dependent, not only upon the assumed average service life of capital, but also upon the parameters resulting from the estimation of the factor demand model. Finally, section 5 is a brief recapitulation, presenting the final framework within which the industry specific factor demand models are estimated.

Although we begin with a four input production function, we derive only three equations in this chapter - investment, demand for production workers, and demand for nonproduction workers. In addition, we report results for only a two equation system in Chapter 5. There are two reasons why the smaller system was estimated. First, energy data at the industry level was not available when this study was undertaken. So, one equation simply could not be estimated. Second, early estimates of a three equation system which distinguished between production and nonproduction workers as well as capital, gave parameter estimates which we felt were unacceptable. A brief discussion of these results is found in Chapter 5. In addition, we found that for forecasting purposes, there was no real need to distinguish between production and nonproduction workers. Consequently, we chose to aggregate labor and estimate one labor requirements equation.

## 2. Theory

We shall assume there exists for each industry in the U.S. economy a twice differentiable production function relating the flow of output, Q, to a vector of 4 inputs: capital (K), production workers (L1), nonproduction workers (L2), and energy (E). Further, we assume that production is characterized by constant returns to scale and that technical change is labor augmenting and capital augmenting, growing at exponential rates $a_2$ and $a_3$ for production and nonproduction workers, respectively; and $a_1$ for capital. Disembodied technical change is assumed to grow at exponential rate $a_D$. The production function may then be written as

$$Q = Q(Ke^{a_1 t}, L1e^{a_2 t}, L2e^{a_3 t}, E)e^{a_D t} \tag{1}$$

Each industry is viewed as seeking to minimize aggregate cost subject to the production function in (1). Then, as was discussed in the previous chapter, underlying this behavorial assumption, there exists a dual cost function to the production function (1) which gives the minimum total cost of producing a given output, Q, subject to an exogeneous vector of input prices. These input prices are given by $\{P_K, P_{L1}, P_{L2}, P_E\}$. The dual cost function may then be written as

$$C(P_t,Q_t,Z_t) = Q_t*C(P_{K_t},P_{L1_t},P_{L2_t},P_{E_t},Z_t,t)e^{-a_D t} \tag{2}$$

where Z represents a vector of nonprice factors influencing cost (possibly only in the short run) and C is the cost per unit of output. The cost function (2) must have continuous first and second partial derivatives and exhibit concavity with respect to prices for all positive values of Q.

For the purposes of this study, a variant of the Generalized Leontief Cost function (GLC) suggested by Diewert is employed. Thus, (2) may be explicitly restated as

$$C(P_t,Q_t,Z_t) = Q_t*(P_t^{.5}BP_t^{.5} + P_t'AZ_t)*e^{-a_D t} \tag{3}$$

where

B = a 4 by 4 symmetric matrix of constants;

Q = output;

$P' = \{P_K, P_{L1}, P_{L2}, P_E\}$;

Z = a vector of nonprice determinants of cost; and

A = a 4 by n matrix of constants with any possible sign pattern short of generating negative costs.[1]

Since the cost function in (3) is assumed to be the dual of the underlying production function in (1), Shepard's Lemma may be applied to derive static, cost minimizing factor demand equations which relate the inputs which are the arguments of (1) to relative prices and output. Doing this gives the following factor demand equations:

$$X_{i_t} = e^{-a_D t} * Q * \{\sum_j b_{ij} (P_j / P_i)^{.5} + \sum_j a_{ij} Z_j\} \quad i = 1, \ldots 4 \quad (4)$$

where

$b_{ij} = b_{ji}$;

$X_i = \{Ke^{a_1 t}, L1e^{a_2 t}, L2e^{a_3 t}, E\}$; and

$P_j$ and $Z_j$ are as previously defined.

One may observe that the $b_{ij}$'s may be estimated directly. However, certain sign patterns on the $b_{ij}$'s can lead to a violation of one or all of the necessary conditions which allow this functional form to lay claim to being the dual of a well behaved production function. To recapitulate, those conditions are:

(i) $C > 0$ for all $Q > 0$ and $P > 0$;

(ii) $\partial C / \partial Q >= 0$ for all $P > 0$;

(iii) $\partial C / \partial P_i >= 0$ for $i = 1, \ldots 4$;

(iv) $\partial^2 C / \partial P^2$ is negative semi-definite.

In the case where $b_{ij} > 0$ for all i,j, conditions (i) through (iv) automatically hold. In the case where not all the $b_{ij}$'s are greater than 0, conditions (iii) and (iv) would be explicitly checked. Conditions (i) and (ii) follow immediately from (iii) and the assumption of constant returns to scale, respectively.

The non-negativity requirement (iii) states that the model generate positive factor demands. This may be immediately checked by observing the predicted values from the estimation. As long as they remain positive, the results remain consistent ~~to~~ with the underlying theory.

To check concavity, the matrix of second partial derivatives,

$$M = \partial X_i / \partial P_j = \begin{cases} -.5\ Q\sum_j b_{ij}\ P_j^{.5} P_i^{-1.5} & i = j \\ .5\ Q*b_{ij}\ P_i^{-.5} P_j^{-.5} & i \neq j \end{cases}$$

must be shown to be negative definite. One may establish negative definiteness by showing that the successive principal minors of -M are all positive in historical prices. If the principal minors are all positive, then -M would be positive definite, implying that M is negative definite.[2]

It is readily seen that allowing negative $b_{ij}$'s leads to considerable difficulties since this liberty makes it necessary to check whether or not the model actually estimated continues to obey all the desirable conditions. However, the non-negativity of elements of B places undesirable restrictions upon the parameter estimates of the cost function.

We may see the relationship between the parameter estimates and the elasticities by computing the Allen partial elasticity of substitution

(AES). Uzawa (3) has shown that the AES, $S_{ij}$, for a pair of inputs i and j is related to the cost function in the following way:

$$S_{ij} = C*C_{ij}/C_iC_j \qquad (5)$$

where $C_i$ and $C_j$ are the partial derivatives of the cost function with respect to the $i^{th}$ and $j^{th}$ prices, respectively. Applying (5) to (3) gives

$$S_{ij} = C*Q*b_{ij}P_i^{-.5}P_j^{-.5}/2*X_iX_j \qquad (6)$$

which is positive for positive $b_{ij}$. This amounts to the requirement that all factors of production be substitutes in the production process. But, it is entirely possible when dealing with more than two factors of production that some inputs are actually complements.[3] Thus, one might typically allow, at least initially, unconstrained signs on the $b_{ij}$'s, permitting the possibility of complementarity among some pairs of inputs.

Estimates of the AES between capital and labor in (6) are reported in Chapter 5. As may be seen in (6) the elasticity measures may differ with differing input prices, factor demands and level of output. In addition, the elasticities clearly will differ among different pairs of inputs. This is a very desirable property of this factor demand system.

## 3. Dynamics

Equation (4) is but an incomplete formulation to use to estimate actual employment of capital, labor and energy by industry over time. There are a number ot reasons further moodification is called for.

First, (4) represents an equilibrium condition. That is, if both prices and output were known with certainty and if, having this information, costs of adjusting factor employment were zero, and, therefore, adjustment were instantaneous, then (4) would be an adequate formulation to empirically estimate factor demand equations. However, the existence of uncertainty about future price behavior leads firms to react to expected relative prices and expected demand, i.e., their perceptions about what prices and demand will be for the relevant future. In addition, the desire to change factor proportions may be costly. The literature on investment has for some time assumed that there exists costs to adjusting the capital stock. And the theoretical work on adjustment costs has demonstrated that these types of costs suggest that a model such as (4) would fail to capture important behavior.[4]

A second reason why (4) is only a partial development of a more complete model has to do with how one estimates the demand-for-capital, on the one hand, and the demand-for-labor, on the other.

We desire to estimate a capital equation which is rooted in the mainstream of empirical work on investment. Consequently, (4) must be modified so that an investment equation may be estimated along with employment equations. In addition, the investment equation must be capable of distinguishing between net investment, with which movements in relative prices and demand are more closely correlated,[7] and replacement investment, which is determined more by patterns and speeds of physical depreciation of the capital stock.

The employment equation presents a different kind of problem. The position taken in this study is that adjusting the level of employment to a change in demand, a movement from one isoquant to another, is relatively costless and that this demand related adjustment may certainly occur within a year. Consequently, the labor employment equation is reformulated as the inverse of average labor productivity. It is felt that in so doing, little is lost by assuming that labor demand adjusts within a year to new output levels. In addition, the employment equation then becomes what amounts to a direct estimation of average labor productivity, a variable with very far reaching implications for the rest of the economy.

Average labor productivity is not, however, completely unrelated to cyclical changes in demand. There is strong evidence that labor exhibits increasing returns over the business cycle.[5] There is little reason to expect movement in relative prices to explain this phenomenon.[6] Consequently, (4) must be modified to incorporate this cyclical behavior while at the same time not allowing such behavior to affect the long term movement in average labor productivity.

These shortcomings of system (4) may be generalized in the following way: (4) is not sufficient as a dynamic model of factor demand. Although this criticism should not come as a surprise, it is, nevertheless, ignored by countless studies over the recent past which have attempted to estimate models of factor demand with more than 2 factors included.[7] The model developed below explicitly introduces dynamics into (4) in a way which preserves the long run structure of factor employment as reflected in the equilibrium condition (4) while at the same time allowing adjustment among the inputs which does not violate the production function constraint underlying the entire analysis.

In empirical work, dynamic behavior implies the existence of distributed lags. Thus, how may lags be properly imposed upon the system ot equations in (4)? To answer this question within the context of a two input model, we may make a distinction between the lags on changes in output, which reflect the dynamics of moving from one isoquant to another; and lags on relative prices, which reflect the movement along any particular isoquant. The former type of lag may be distinct for each input. The latter must be identical among pairs of inputs.

To gain a clearer picture of the proper lag structures, consider a continuous concave production function of two inputs, K and L: $Q = Q(K,L)$. The function may be represented in two dimensions by a pair of isoquants. The two isoquants displayed in figure 1 show that, initially, inputs $\{L_0,K_0\}$ are employed at prices $\{P_L^0, P_K^0\}$ to generate output $Q_0$. Now assume that, as relative prices remain unchanged, demand increases to $Q_1$ , which leads, in the new equilibrium, to factor employment of $\{K_1,L_1\}$. The question then becomes: what path does the firm take to get from $\{L_0,K_0\}$ to $\{L_1,K_1\}$? The answer is that there are many possible paths which might be taken which are not inconsistent with the underlying production function. In figure 1, arrows numbered 1 and 2 represent steps taken in each of the first two periods after the new demand is discovered. According to this path, the employment of L adjusts completely in the first period while K adjusts not at all in the first period, but completely in the second period. Realistic or not, such a dynamic path from one equilibrium to another does not in any way

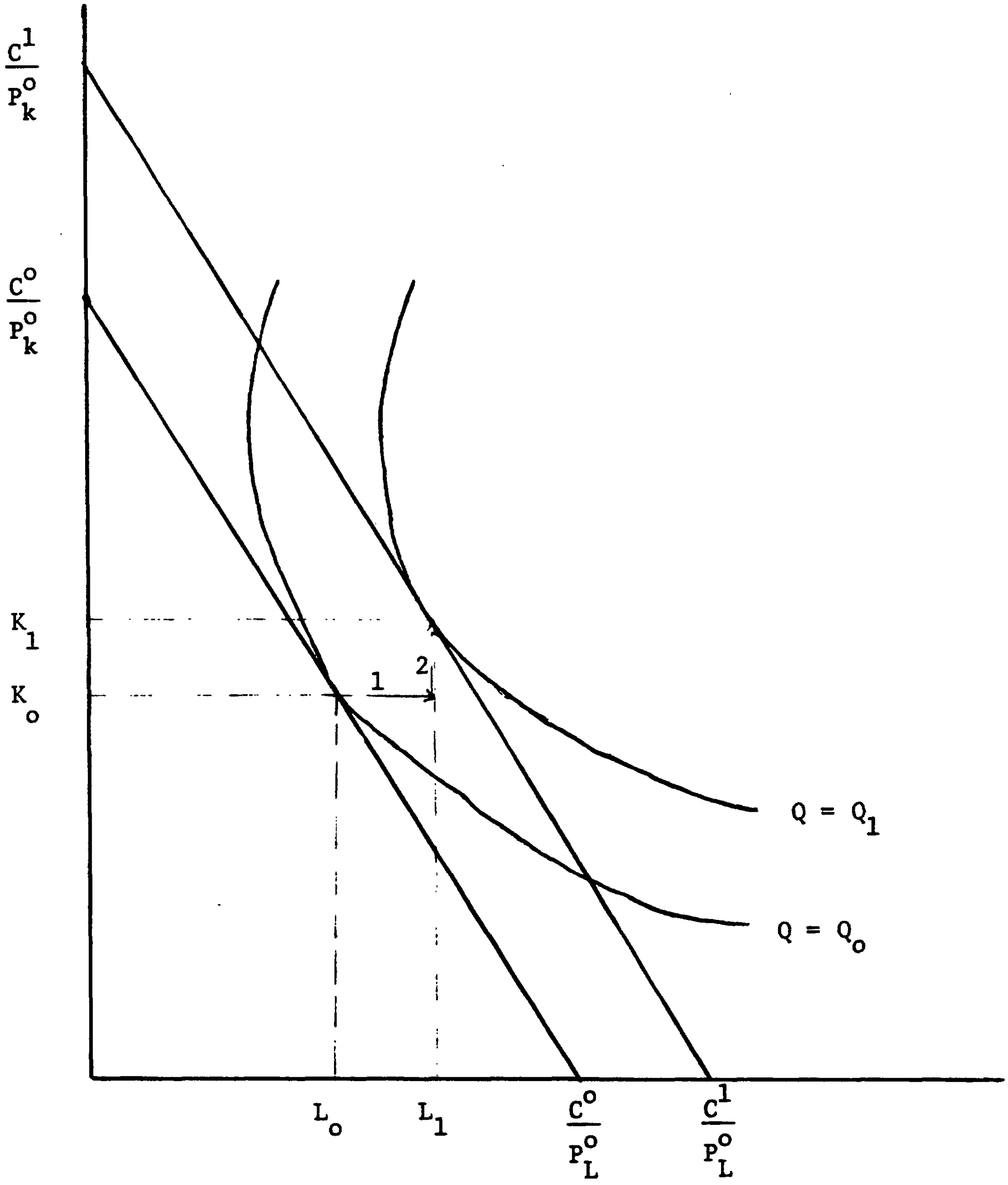
$\frac{C^1}{P_k^o}$
$\frac{C^o}{P_k^o}$
$K_1$
$K_o$
1
2
$Q = Q_1$
$Q = Q_o$
$L_o$
$L_1$
$\frac{C^o}{P_L^o}$
$\frac{C^1}{P_L^o}$

FIGURE 1

violate the production function constraint. The path in figure 1 is an illustration of the fact that the speed of adjustment of one input in response to demand changes may be different from the speed of adjustment of the other input. One could easily draw a path from $\{L_0,K_0\}$ to $\{L_1,K_1\}$ which would imply the same speed of adjustment, a straight line from the point $\{L_0,K_0\}$ to $\{L_1,K_1\}$, but there is no requirement that such a path should be taken.

Now look at figure 2 to consider the dynamic behavior of factor employment holding output constant. Equilibrium is again $\{L_0,K_0\}$ employed at prices $\{P_L{}^0, P_K{}^0\}$ generating output $Q_0$. Now assume the price of K declines to $P_K{}^1$, while the price of L remains at $P_L{}^0$. The new equilibrium then becomes $\{L_1, K_1\}$ at prices $\{P_L{}^0, P_K{}^1\}$. Assume that substituting L for K is not costless so that the optimal pattern of adjustment requires, say, two periods. Let the arrows numbered 1 and 2 each represent 50 percent of the total movement to the new factor proportions which occur in the first and second period, respectively. As may be seen, the only way to remain on the indifference curve, producing optimally, would be to require both L and K to adjust according to the same time pattern. Consequently, the dynamic behavior percipitated by price changes must be identical among pairs of inputs in order to remain on the production function.

In the three input case, the problem becomes a little more complicated. For, a change in one input price, holding other prices and output constant, leads to an adjustment in all three inputs simultaneously. Such a process may only be modeled in three dimensional space, so the discussion above is not completely satisfactory. Under what conditions, then, may the dynamic structure be specified so that

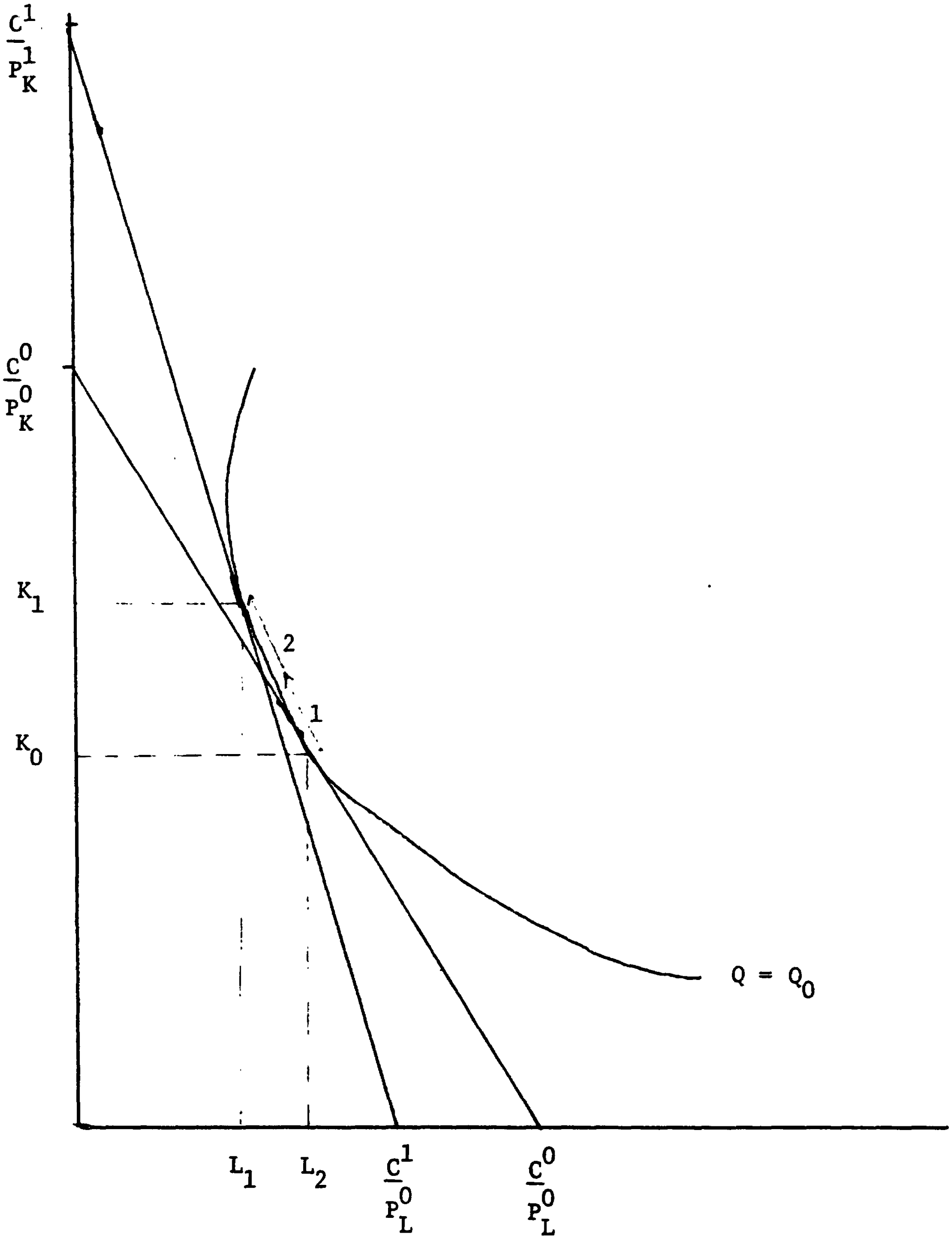

FIGURE 2

the simultaneous movement of three inputs, holding output constant, does not lead to input combinations which are better than optimal.? Although the question has occured to us, the solution has not. What is clear is that the lag structures must be related in a more complex way. For example, in a three input case, there exists three distributed lags which describe the response of the respective inputs to a change in any one input price. Given a level of output and any two input levels, the third is determined. Correspondingly, given any two of the three lag distributions, the third is determined. More concretely, if we know the level of production, and we know the response pattern of capital and labor to a change in energy prices, we may then determine the response pattern of energy to its own price. To date, we have been unable to specify, analytically, the lag structures in the three input case to account for the apparent interrelatedness. However, there are two reasons why a failure to provide a more general specification for the lag structures should not be viewed with alarm. First, the manner in which the lags are specified at least permits reasonable dynamic behavior; and, second, since we ultimately estimate only a two equation system, the more general lag formulation is not directly relevant to our empirical results.

With these considerations in mind, equation (4) may now be modified to incorporate dynamic behavior. The investment equation will be dealt with first.

**Investment**

The desired capital stock equation is converted into a desired net investment equation by taking derivatives and then approximating derivatives with first differences, to yield:

$$N_t^* = e^{-a_K t} \Delta Q_t * \Sigma b_{Kj} (P_j/P_K)^{.5^*} + e^{-a_K t} Q * \sum_j b_{Kj} \Delta (P_j/P_K)^{.5^*} \qquad (7)$$

$$- a_K e^{a_K t} Q \sum_j b_{Kj} (P_j/P_K)^{.5}$$

where the stars on the independent variables signify that they are expected, unobserved variables, and $a_K = a_1 + a_D$. This equation may be written in a more comprehensible form by observing that the desired capital-output ratio is given by

$$(K/Q)^* = e^{-a_D t} \sum_j b_{Kj} (P_j/P_K)^{.5^*}$$

so that (7) may be rewritten as

$$N_t^* = \Delta Q_t^* * (K/Q)^* + a^{-a_K t} Q^* \sum_j b_{Kj} (P_j/P_K)^{.5^*} - a_K K_t^* \qquad (8)$$

So written, (8) allows one to neatly distinguish between investment percipitated by changing demand, which is the first term on the right hand side of (8), and investment brought about by changing relative prices, the second term on the right hand side of (8). If all $b_{kj} = 0$ for $k \neq j$, and if embodied technical change is zero, then capital would stand in fixed proportions to output, where

$$(K/Q)^* = b_{KK};$$

and investment would respond only to changes in demand:

$$N_t^* = b_{KK} \Delta Q_t^*$$

This result will have implications for the productivity equations, as we will see below.

In accordance with the previous discussion, actual net investment responds to observed changes in prices and output with a lag. Therefore, approximating $(K/Q)^*$ by $(K/Q)_{t-1}$, and introducing lags yields an expression for actual net investment:

$$N_t = (K/Q)_{t-1} * \sum_{\ell} W_{\ell} \Delta Q_{t-\ell} + e^{-a_K t} Q_t \sum_j \sum_{\ell=0}^{m_{Kj}} {}^{?} b_{\ell}^{Kj} \Delta (P_j/P_K)^{.5}_{t-\ell} \qquad (9)$$

$$-a_K K_{t-1}$$

where

$$\sum_{\ell=1}^{n} W_{\ell} = 1;$$

$$\sum_{\ell} b_{\ell}^{KJ} = b_{Kj};$$

$n$ = length of lag on changes in output;

$m_{kj}$ = length of lag on changes in the kth relative price; and

$N_t$ = actual net investment.

To arrive at a model for gross investment, an expression for replacement investment must be appended to (9). The derivation of this expression is explained below as well as the measure of the capital stock.

Production Workers

Dividing the first labor employment equation in (4) by Q gives an expression for the inverse of average labor productivity, consistent with the underlying production function:

$$(L_1/Q)_t^* = e^{-a_{L1}t} \sum_{j=1}^{4} b_{L1j} \, (P_j/P_{L1})_t^{.5}$$

where $a_{L1} = a_2 + a_D$. Incorporating lags as for the investment equation yields

$$(L_1/Q)_t^* = e^{-a_{L1}t} \sum_{j=1}^{4} \sum_{\ell} \beta_{\ell}^{L1j} \, (P_j/P_{L1})_{t-\ell}^{.5}$$

where

$$\sum \beta_{\ell}^{L1j} = b_{L1j} \; ; \qquad \text{and}$$

$$\beta_{\ell}^{L1K} = \beta_{\ell}^{KL1} \qquad \ell = 1, \ldots m_{L1K}$$

As mentioned above, there is evidence of cyclical productivity behavior which, this study holds, may not be explained by the theory. Consequently, the productivity equation must be amended to include a cyclical component. The hypothesis is that actual productivity is given by

$$(L1/Q)_t = (L1/Q)_t^* * (1 + \theta_t (\Delta Q))$$

where $(L1/Q)^*$ is defined in (10), and $\theta$ represents the cyclical variation of productivity about its price determined path. $\theta$ is required to have the property that it not influence the long run behavior of average labor productivity. It, therefore, is defined in the following way:

$$\theta_t(\Delta Q) = \sum_{i=1}^{4} V_i^1 \Delta Q_{t-i}$$

where the $v^1$'s are required to sum to zero. This lag is constrained to 4 years since this length of time corresponds, approximately, to the average length of a business cycle during the post war period. To support the hypothesis of increasing returns to labor over the cycle, one would expect the v's to be negative in the most recent part of the lag, and positive towards the end of the lag.

?

With these modifications, and approximating $(L1/Q)^*$ with a four year moving average of production workers per unit of output, lagged one period, the final form for the productivity equation becomes:

$$(L_1/Q)_t = e^{-a_{L1}t} \prod_j \sum_{\ell=0}^{m_{L1K}} \beta_\ell^{L1j} (P_j/P_{L1})^{.5}_{t-\ell} + (L/Q)_{t-1}^* \Sigma V_i^1 \Delta Q_{t-i} \quad (10)$$

## Nonproduction Workers

The equation and constraints for the nonproduction worker equation are similiar to those for production workers. The equation is:

$$(L_2/Q)_t = e^{-a_{L2}t} \sum_j \sum_{\ell=0}^{m_{L2K}} \beta_\ell^{L2j} (P_j/P_{L2})^{.5}_{t-\ell} + (L/Q)_{t-1} * \Sigma v_i^2 \Delta Q_{t-i} \quad (11)$$

where

$$\sum_\ell \beta_\ell^{L2j} = b_{L2j} \quad ;$$

$$\beta_\ell^{L2K} = \beta_\ell^{KL2} \qquad \ell = 1,\ldots m_{L2K}$$

$$\beta_\ell^{L2L1} = \beta_\ell^{L1L2} \qquad \ell = 1,\ldots m_{L2L1}; \quad \text{and}$$

$$\sum_{i=1}^{4} v_i^2 = 0$$

One may note what happens to the productivity equations should capital be insensitive to relative prices. In such a case, average productivity for production and nonproduction workers would, in addition, be insensitive to capital's price. The productivity of different kinds of labor would then become a function of the relative prices of different kinds of labor, a trend and a cyclical variable.

## 4. Replacement Investment

Like with other work on investment behavior, this study posits that replacement investment is determined by speeds and patterns of physical depreciation of the capital stock. To estimate replacement investment, therefore, one must derive an expression for the physical deterioration is $d_i$ same as $\phi_i$?

of the capital stock. Let $\phi_i$ be the fraction of the original productive capacity of a capital good which is lost in the $i^{th}$ period after its acquisition. Depreciation in period t, assuming $d_0 = 0$, is ? then given by

$$R_t = \sum_{i=0}^{\infty} \phi_i I_{t-i} \tag{12}$$

where $I_{t-i}$ is real gross investment in year t-i and

$$\Sigma \phi_i = 1.$$

The most widely used pattern of depreciation is that of geometric decay where the rate of decay is a function of the inverse of the average service life of the capital equipment. In this case, $d_i = \lambda^i(1-\lambda)$, where $\lambda$ is the rate of retention.

The geometric decay pattern of depreciation has one major advantage and one major disadvantage. The advantage is that in estimating and forecasting investment, one need not recompute (12) in each year, and, therefore, no need exists to "remember" the whole history of equipment purchases to determine replacement in each year. It is sufficient to have at hand only the current capital stock. This may be shown by rewriting (12), using the geometric rate of decay pattern as

$$R_t = (1-\lambda) \sum_{i=1}^{\infty} \lambda^i I_{t-i}$$

Now $(1-\lambda)$ is the rate of decay, as stated above, so that $\lambda$ is the rate of retention. It then follows that $\lambda^i$ is the fraction of equipment purchased in one year which is still retained in the $i^{th}$ period after it is purchased. Since the capital stock is defined as the sum of all past investment which is retained (has not yet depreciated), we then have

$$K_{t-1} = \sum_{i=1}^{\infty} \lambda^i I_{t-i} \tag{13}$$

and

$$R_t = (1-\lambda)*K_{t-1}$$

Thus, depreciation at time t is a constant proportion of the capital stock.

The major disadvantage of this pattern of depreciation is that equipment very likely does not depreciate in this way. While the value of capital may diminish geometrically, the quantity (in terms of productive capacity) certainly does not. If equipment has an average service life of ten years, the geometric pattern would suggest that only about 60 percent of the productive capacity of the equipment remains in use after five years, when, most likely, nearly all of the equipment remains.[8] Thus, the geometric decay pattern gives estimates of the quantity of capital which tend to understate the true quantity of capital.

A more general approach has been suggested. Namely, create a second, fictitious, class of capital, into which the depreciation out of the first class of capital falls.[9] Thus, if $K_1(t)$ is the first class capital at time t, and $K_2(t)$ is the second class capital at time t, then we have

$$K_1(t) = I_t + \lambda * K_1(t-1)$$

$$K_2(t) = (1-\lambda) * K_1(t-1) + \lambda * K_2(t-1)$$

The total capital stock at time t is then defined as

$$K(t) = K_1(t) + K_2(t) \tag{14}$$

With this scheme, depreciation is given by

$$R_t = (1-\lambda)*K_2(t-1) \tag{15}$$

This pattern suggests that, at first, depreciation of equipment is very slow, then increases to a maximum, then recedes. See Figure 3 for a comparison of depreciation under the two schemes. Going back to (12), then, the curve resulting from constructing the two classes of capital defines the $\phi_i$'s, which as as may be seen from Figure 3, differ markedly from the geometric decay pattern.

This approach allows for what may be a more reasonable pattern of physical depreciation for some industries while maintaining the computational simplicity of the geometric decay pattern. The procedure requires only one extra piece of information, namely, a second class or "bucket" of capital, in addition to the first one. This information is then sufficient to determine both depreciation, as shown in (15), and

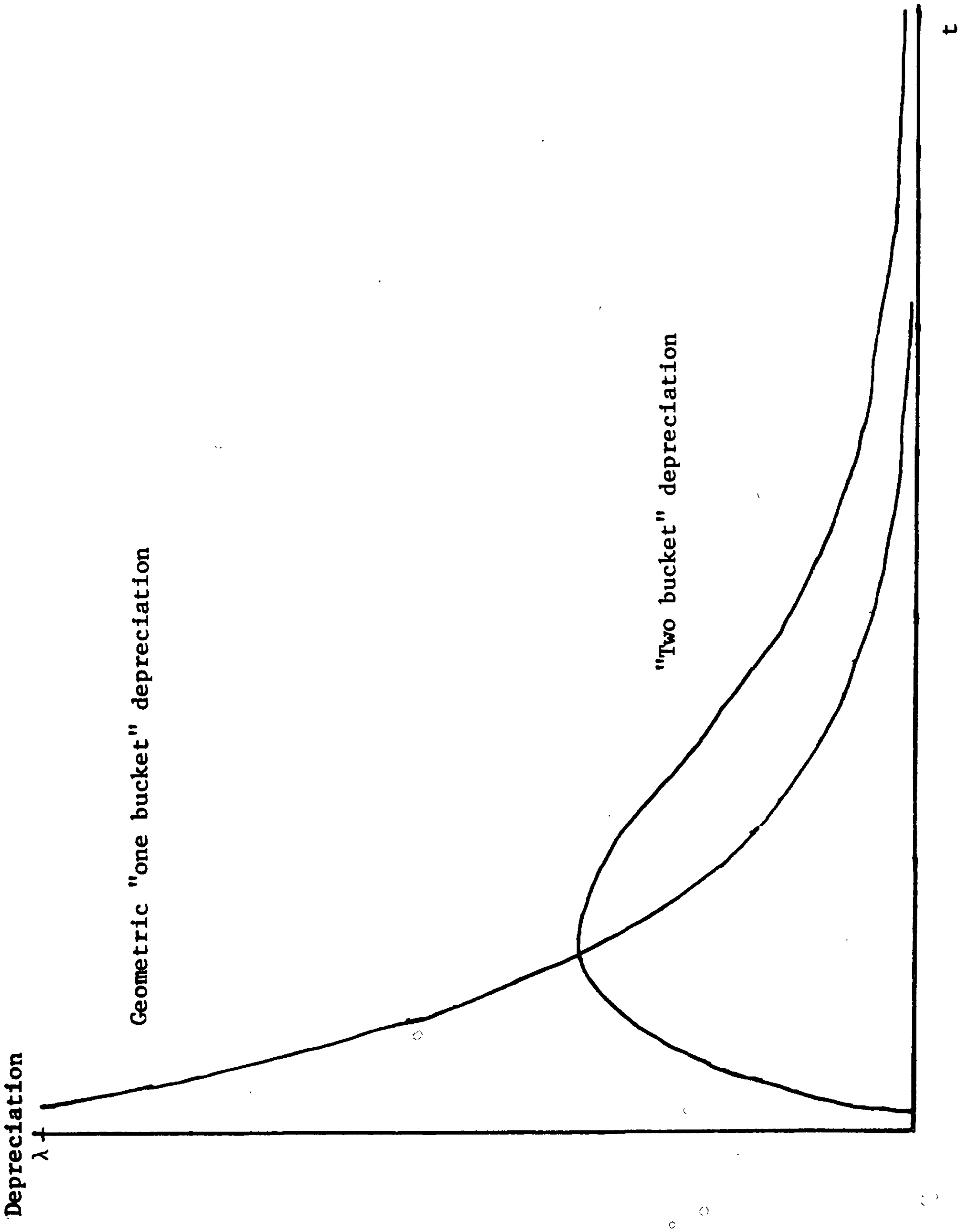

FIGURE 3. Depreciation pattern for one dollar's worth of equipment

the measure of the capital stock, as shown in (14).

## A More General Approach

Both the geometric decay pattern and the "two bucket" approach to measuring depreciation are specific applications of imposing a Pascal lag distribution on the $\phi_i$'s in (12). For such a distribution, we have

$$\phi_i = \begin{cases} 0 \text{ if } i = 0 \\ \\ \{(i+r-1)!/i!(r-1)!\}*(1-\lambda)^r*\lambda^i \text{ if } i > 1 \end{cases}$$

where r is some positive integer. In the case where r = 1, $\phi_i = (1-\lambda)\lambda^i$, which is the geometric decay pattern mentioned above. In the case where r = 2, we have $\phi_i = (i+1)(1-\lambda)^2\lambda^i$, which, I will now show, describes the depreciation resulting from the two bucket pattern.

In general, for any value of r, we can write the distributed lag associated with the Pascal distribution as

$$R_t = (1-\lambda/1-\lambda L)^r \ I_t$$

where L is the lag operator.

Therefore, to show that the two bucket depreciation pattern, $R(t) = F(L)*I_t$, shown in Figure 3, is the result of imposing a Pascal lag with r = 2, one need only show that

$$F(L) = \{(1-\lambda)/(1-\lambda L)\}^2$$

From (13) we may write the following:

$$K_1(t) = \Sigma\ \lambda^i\ I(t-i) = \Sigma\ (\lambda L)^i * I(t) = (1/1-\lambda L)\ I_t$$

$$K_2(t) = \Sigma\ \lambda^i\ (1-\lambda)*K_1(t-i) = (1-\lambda)\ \Sigma(\lambda L)^i * K_1(t) = (1-\lambda)/(1-\lambda L)*K_1(t)$$

Therefore,

$$R(t) = (1-\lambda)\ K_2(t-1) = (1-\lambda)^2/(1-\lambda L)\ K_1(t) = \{(1-\lambda)/(1-\lambda L)\}^2 * I(t)$$

which is what we wanted to show.

For this study, a further generalization of the two depreciation schemes presented above will be introduced. This generalization will allow for the possibility that any convex combination of Pascal lags with r = 1, 2, or 3 may best reflect the depreciation of equipment by industry. Therefore, the pattern of depreciation as well as the average service life ot equipment may differ by industry.

The approach is as follows: depreciation is defined as a weighted average of the lag patterns generated by a first, second and third degree Pascal lag, where the weights are determined in the estimation of the equation. Therefore,

$$R_t = \{d_1 (1-\lambda/1-\lambda L) + d_2 (1-\lambda/1-\lambda L)^2 + d_3 (1-\lambda/1-\lambda L)^3\} I_t \quad (16)$$

where

$$\sum_{i=1}^{3} d_i = 1$$

With this definition of replacement, $\phi_i$ is then defined as a weighted average of the $\phi_i$'s which correspond to Pascal lags of one, two and three degrees. Computationally, the implementation of this pattern is straight forward. Define three "buckets" as follows:

$$B_1(t) = I(t) + \lambda B_1(t-1)$$

$$B_2(t) = (1-\lambda) * B_1(t-1) + \lambda * B_2(t-1)$$

$$B_3(t) = (1-\lambda) * B_2(t-1) + \lambda * B_3(t-1)$$

Now define three "spills" from the three buckets as follows:

$$D_1(t) = (1-\lambda) * B_1(t-1)$$

$$D_2(t) = (1-\lambda) * B_2(t-1)$$

$$D_3(t) = (1-\lambda) * B_3(t-1)$$

Then depreciation is defined as

$$R_t = \sum_{i=1}^{3} d_i \; D_i(t) \tag{17}$$

where

$$\sum_{i=1}^{3} d_i = 1.$$

The $d_i$'s enter linearly into the regression, consequently, the $d_i$'s may be easily estimated and will vary by industry.

It may be easily seen that this approach admits as possible industry depreciation patterns either the geometric or the two bucket results. Referring to (16), in the case where $d_2 = d_3 = 0$, then $d_i = 1$ and the depreciation patter is geometric. If $d_2 = 1$, then the pattern is that which results from the two bucket approach. In the case where $d_i$'s are between 0 and 1, the result is some intermediate pattern.

It is clear why the sum of the d's must be unity, for only in that case will each dollar of capital investment be depreciated once and only once. As one dollar in investment passes through the "buckets", $d_1$ percent is written off as it leaves $B_1$, $d_2$ percent is written off as it leaves $B_2$ and the remaining $d_3$ percent is written off as it passes out of $B_3$. If the sum of the d's were less than unity, not all of the dollar's worth of capital would depreciate; while, should the sum of the d's be greater than one, the total depreciation would be greater than the original investment.

With this method of determining depreciation, a straight- forward expression for the capital stock results. Since all investment goes into $B_1$, all of $B_1$ must be a part of the capital stock. Now, recall that the fraction $d_1$ of the spill from $B_1$ counts as depreciation, so that $1 - d_1$ is the fraction of the spill which represents capital held for a while in $B_2$. Hence, $(1 - d_1)*B_2$ represents capital stock held in $B_2$. Similarly, $d_2$ represents that portion of the spill from $B_2$ which counts as depreciation. Consequently, $(1-d_1-d_2)*B_3$ is that portion of $B_3$ which represents capital stock. The total capital stock expression, then, is given by the following sum:

$$K_t = B_1 + (1-d_1)*B_2 + (1-d_1-d_2)*B_3. \tag{18}$$

## 5. Summary

Combining the specification of replacement investment (17) with the net investment equation (9) provides the gross investment equation which is estimated. The complete model includes, then, the demand for gross investment, production workers (10) and nonproduction workers (11). The model is displayed in equation system (19). What emerges is a model of factor demand with the following characteristics:

(i) Investment is a function of changes in output and changes in relative prices. The input prices include the wages of production and nonproduction workers, the price of energy, and the price of capital.

(ii) Should the model lead to the conlcusion that investment is insensitive to relative prices, the investment equation then reduces to the familiar flexible accelerator model with constant returns to scale.

(iii) Employment of production and nonproduction workers are

$$N_t = (K/Q)_{t-1}^{*} \sum_{\ell} W_{\ell} \, \Delta \, Q_{t-\ell} + e^{-a_K t} \, Q_t \sum_{j} \sum_{\ell=0}^{m_{Kj}} \beta_{\ell}^{Kj} \, \Delta \, (P_j/P_K)^{.5}_{t-\ell}$$

$$-a_K K_{t-1} + \sum_{i=1}^{3} d_i \, D_i \qquad (19)$$

$$(L_1/Q)_t = e^{-a_{L1} t} \sum_{j} \sum_{\ell=0}^{m_{L1K}} \beta_{\ell}^{L1j} \, (P_j/P_{L1})^{.5}_{t-\ell} + (L/Q)_{t-1}^{*} \sum V_i^1 \, \underline{\Delta} \, Q_{t-i}$$

$$(L_2/Q)_t = e^{-a_{L2} t} \sum_{j} \sum_{\ell=0}^{m_{L2K}} \beta_{\ell}^{L2j} \, (P_j/P_{L2})^{.5}_{t-\ell} + (L/Q)_{t-1} {}^{*} \sum V_i^2 \, \underline{\Delta} \, Q_{t-i}$$

where

$\Sigma W_{\ell} = 1$

$\beta_{\ell}^{KL1} = \beta_{\ell}^{L1K} \qquad \ell = 1, \ldots m1K$

$\Sigma d_i = 1$

$\beta_{\ell}^{L1L2} = \beta_{\ell}^{L2L1} \qquad \ell = 1, \ldots m_{L1L2}$

$\Sigma \, V_i^1 = \Sigma \, V_i^2 = 0$

$N_t$ = investment

L1 = production workers

L2 = nonproduction workers

functions of the levels of relative prices, an exponential time trend which differs between the two, and cyclical variables. These cyclical variables allow for the presence of increasing returns to labor in the short run, as found in other studies. The use of the stock of capital relative to labor is avoided because the stock is both difficult to measure and may be affected by environmental or safety regulations that have no impact on productivity, except in the very long run.

(iv) The result of deriving the model leads to a system in which individual parameters appear in more than one equation. This fact becomes the crucial link among the equations. Consequently, the long run response of capital to the price of labor relative to capital must be identical to the long run response of labor to the price of capital relative to labor.

(v) The dynamic properties of the model are consistent with the underlying production function. Consequently, the adjustment paths of input demands resulting from changing output demand differ among the inputs; while the adjustment path of input i in response to the ij$^{th}$ relative price must be identical to the adjustment path of input j to the inverse of the ij$^{th}$ relative price, for all i,j.

(vi) The method of estimating replacement investment leads to industry specific patterns of depreciation. The geometric pattern used by most researchers is a special case of the flexible approach use in this study. A simple method for computing the capital stock results.

## FOOTNOTES

1. The quadratic expression in prices and "other" variables in no way changes the necessary properties of the Diewert cost function as was stated in Chapter 2. For example, the cost function must be homogeneous of degree ~~zero~~ one in input prices and give factor demand equations which are homogeneous of degree zero in ~~input~~ all prices. One may observe by inspection that the cost function (4) is linearly homogeneous in prices and that the factor demand equations resulting from this cost function are homogeneous of degree zero in prices.

2. If any of the $b_{ij}$'s are negative, there will always be some vector of prices in the positive price space for which the concavity requirement is violated. What is desirable,however, is to look at the region within which prices are reasonably expected to occur. Admittedly, checking concavity only at historical prices will not exhaust the region. It seems more practical to check concavity only at historical prices and, in the cases where this requirement is violated, certain parameters will simply not be allowed to be negative in the estimation. The usefulness of the model will then be based upon its ability to fit the data in the history given that is satisfies all the desirable properties of the cost function.

3. See Chapter 3, section 3 for discussion.

4. The theoretical work has been done by Treadway, see references to Chapter 2.

5. Increasing returns to labor in the short run is counter-theoretical due to the perception that the short run production function with capital fixed should exhibit diminishing returns to labor. This

perception is justified by arguing that over the cycle, less productive labor is employed to meet short run increases in demand which in turn should lower average labor productivity over the cycle.

6. For a brief survey of the historical explanations of this cyclical behavior, see White and Berndt (2). Also, various issues of the *Brookings Papers on Economic Activity* deal extensively with this subject.

7. A number of studies are listed in Chapter 2.

8. The rate of depreciation of a geometric lag with mean 10 years is is 0.909 . With this depreciation rate, the amount retained after 5 years is equal to $.91^5$ , which equals .62 .

9. See (1).

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# Chapter 4

# Construction of Data

The model described in the previous chapter was estimated for each of 53 industries which cover the entire U.S. economy. The titles for these industries are listed in Appendix A. Consequently, data on employment, investment, outputs, the relevant input prices and a first guess at the capital stock must be gathered and constructed for each of these industries. The methods and sources used to compile the data for the model is reviewed in this chapter.

## Gross Investment

The investment data used for thar study is based upon a collection of 87 1977 dollar investment series beginning in 1927 which are the result of research by the INFORUM project. These series have been used in the past to estimate investment equations which make up part of the INFORUM model. With one exception, there exists a consistent aggregation scheme from these 87-order INFORUM investment sectors to the 53 investment sectors used in this study. Consequently, the sources for the investment data are those of the INFORUM investment sectors and are described in detail in (2).

Further work was undertaken, however, to disaggregate the Finance, Insurance and Service sector (FIS) in the INFORUM classification (no.86), into seven service subsectors, making use of recently constructed data. These sectors are:

| Sector | Title |
|---|---|
| 49 | Finance and Insurance |
| 50 | Real Estate |
| 51 | Hotels and Repairs Minus Auto |
| 52 | Business Services |
| 53 | Auto Repair |
| 54 | Movies and Amusements |
| 55 | Medical and Educational Services |

The construction of service sector investment was accomplished by making use of two separate sources of information.

On the one hand, owing to the data work completed for the INFORUM model, there exists at least an approximation of what total investment by FIS was over the history. This approximation was computed as the difference between the total current dollar purchases of equipment at time t and the sum of equipment purchases by all other industries at time t, the latter derived from various sources described in (2).[1] Consequently, FIS investment is computed as a residual in the INFORUM model. Although there are problems with this method of computing investment, and therefore inaccuracies in the resulting time series, it was felt, nevertheless, that the computed time series would be used as the basis for determining investment by the service sectors for this study.

The Bureau of Labor Statistics (BLS) provides in (4) seven service sector investment series up to 1974, and in both current and constant 1972 dollars. They correspond exactly to the seven listed above. We desired to use this data, combined with the information embodied in the residual INFORUM sector no.86, to construct time series by individual service sectors in 1977 dollars through 1977. This combination was done in the following steps:

(i) The BLS investment series were moved forward to 1977 by their respective current and 1972 dollar outputs. This provided time series in current and 1972 dollars of investment by various service sectors up to 1977.[2]

(ii) These series were then scaled in each year of the history to the FIS totals derived for the INFORUM model. This then provided series in current and 1972 dollars which remained consistent with work previously done by INFORUM while at the same time incorporating the information embodied in the disaggregated data provided by BLS.[3]

(iii) Using the investment series thus created, investment deflators were then constructed for each service industry. Using these deflators, 1977 dollar investment to 1977 was then computed from the current dollar series.

Investment in years prior to 1947 exists for aggregate FIS. The assumption made for this study is that the proportion of investment by individual service industries to aggregate FIS in 1947 holds prior to 1947. The earlier FIS investment was apportioned accordingly.

## Output

Outputs by investing industries are derived from various sources, many of which provide indexes by which we move forward the outputs given in the 1972 BEA input-output table. The time series used for this study again draw heavily upon work undertaken on behalf of the INFORUM project. The outputs are, consequently, simple aggregates of the

INFORUM 200 level outputs. The sources are described in (2).

## Employment

Using data available from Employment and Earnings (EE), total employment of production and non-production workers from 1947 are distinguished in manufacturing industries. In some manufacturing industries, however, employment data did not extend back to 1947. In these cases, data was constructed in one of two ways.

In most cases, it was possible to compute employment by, say, three-digit SIC as a residual resulting when subtracting from the two-digit SIC classification the sum of employment of all three-digit SIC sectors which make up the two-digit category and which, together with the residual sector, exhaust the category.

In fewer cases, data was constructed by maintaining back to 1947 the earliest possible ratio of employment of the relevant three-digit SIC category to the employment of the two-digit SIC category of which it was a member. All two-digit categories had data back to 1947.

To illustrate, let $E_k(t)$ be the total employment at time t of the $k^{th}$ two-digit SIC sector and let $E_i(t)$ be the employment of the $i^{th}$ three-digit SIC sector such that $E_i(t)$ is a subset of $E_k(t)$. For each i, let T be the first year for which employment data exists at the three-digit level. $E_i(t)$, $t = 1,...T - 1$, are, consequently, unknown. This earlier data is then constructed as follows:

$$E_i = E_k * \{E_i(t)/E_k(t)\} \qquad t=1,...T-1; \quad i \varepsilon I_k \qquad (1)$$

where

$I_k$ = set ot three-digit SIC sectors in the $k^{th}$ two-digit SIC sector.

In this way, the sum of employment by three-digit SIC equals the total employment number ot the relevant two-digit sector for all years:

$$\sum_i E_i = \sum_i E_k * \{E_i(t)/E_k(t)\} = E_k(t) \qquad t=1,\ldots T-1$$

since

$$\sum_i E_i(t)/E_k(t) = 1.$$

Total employment for the nonmanufacturing sectors were taken directly from work previously undertaken.[4]

## Average Hourly Compensation and Average Weekly Hours

The construction of average hourly compensation data for manufacturing proceeded in three stages. First, average hourly wages for production workers were collected; and, where necessary, wage data was constructed back to 1947. Next, wages for nonproduction workers were inferred from a combination of aggregate manufacturing data and industry specific wage data for production workers. Finally, average hourly compensation for production and nonproduction workers was constructed. A description of each of these stages follows.

EE provides data on wages and hours worked, in most cases, back to 1947. In cases where data does not exist back to 1947, the procedures used to construct the employment series were likewise used to project back both wages and average weekly hours, i.e.,

$$W_i(t) = \{W_i(t)/W_k(t)\}*W_k(t)$$

$$H_i(t) = \{H_i(T)/H_k(T)\}*H_k(t) \qquad t=1,\ldots T-1; \quad i\varepsilon I_k$$

where

T and $I_k$ are defined as above, and:

$W_k(t)$ = average hourly compensation of the $k^{th}$ two-digit SIC sector;

$H_k(t)$ = average weekly hours of the $k^{th}$ two-digit SIC sector;

$W_i(t)$ = average hourly wage of the $i^{th}$ three-digit sector, such that $i \varepsilon I_k$;

$H_i(t)$ = average weekly hours of the $i^{th}$ three-digit SIC sector, such that $i \varepsilon I_k$.

This procedure allows the maintenance of consistency between the weekly wage bill by two-digit SIC and the same wage bill computed by summing over the three-digit SIC sectors.

Using the following manufacturing data from the National Income and Product Accounts(NIPA), average hourly earnings for non-production workers in total manufacturing may be inferred.

(i) average hourly earnings for production workers

(ii) average weekly earnings for production workers

(iii) total production workers

(iv) total wages and salaries, all workers

(v) total hours for all employees in production

(vi) total compensation for all employees.

Total wages and salaries for production workers is given by (i) * (ii) * (iii) * 52. Subtracting this quantity from (iv) gives total wages and salaries for non-production workers. Total hours for non-production workers is given by (v) - (ii) * (iii) * 52. Once wages for non-production workers are computed, the ratio of non-production worker's wages to production worker wages is then constructed, which, in turn, is used to compute non-production worker wages at the industry level. Thus, for sector M, at time t, the wage for non-production workers is given by

$$W_2(M,t) = \{W_2(t)/W_1(t)\}*W_1(M,t)$$

where

$W_2(M,t)$ = wage of non-production workers for sector M at time t

$W_1(M,t)$ = wage of production workers for sector M at time t

$W_2(t)$ = all manufacturing non-production wages at time t

$W_1(t)$ = all manufacturing production wages at time t.

After this calculation, it remains to convert the average hourly earnings data to average hourly compensation for production and nonproduction workers, the cost of employing labor which should enter the equations. There exists Gross Product Originating (GPO) data on average hourly compensation for all employees for 38 industries, which are direct aggregates of the 53 investment/productivity industries. I assumed that the ratio of total compensation for nonproduction workers to total compensation for production workers was identical to the like ratio for wages and salaries. The 53 wage series for production and nonproduction workers were then scaled upwards in a way which preserved the relative size of the compensation bill of the 53 sectors within the appropriate GPO sectors.

Once the wage, hours and employment data are constructed back to 1947, they are then aggregated into the appropriate 53 order sectors and scaled to equal the aggregate totals in the NIPA.

Average hourly compensation data for nonmanufacturing industries were taken directly from the GPO series.

## Energy Prices

Energy prices faced by industry were computed using the input-output coefficients in the 1972 I-0 table relevant to each industry being studied.

Let $e_{ij}$ equal the ratio of the $i^{th}$ energy input to the $j^{th}$ industry's output. For this work, there are five energy inputs. They are

(i) refined petroleum products excluding fuel oil
(ii) coal
(iii) natural gas utilities
(iv) electric utilities
(v) fuel oil

Let $P_i(t)$ be the output deflator for the $i^{th}$ energy input at time t. Then the energy price faced by the $j^{th}$ industry at time t is given by

$$P_j^e = \sum_i \{e_{ij} * P_i(t)\} / \sum_i e_{ij}$$

This provides a time series of energy prices from 1947 to the present for each industry, differing by industry. The shortcoming of this approach is that it assumes that the relative proportions of different energy sources remains constant.

### User Cost of Capital

The user cost of capital is given by

$$U_k = P_{eq} * (r+dep) * (1-Tz-C)/(1-T)$$

where

$P_{eq}$ = price of equipment;
$r$ = real rate of discount;
$dep$ = the physical depreciation rate;
$z$ = the present value of a depreciation stream from a dollar's worth of investment;
$C$ = investment tax credit;
$T$ = corporate tax rate.

T and C were the easiest components to compute since they were taken directly from Internal Revenue Service Publications. No special effort was made to compute effective rates at the industry level.[5]

which?

The determination of the price of equipment is described in (2) for the 87 INFORUM sectors. The corresponding equipment prices used for this study were computed as weighted averages of the 87 equipment prices, where the weights were the ratios of investment in each year in the $i^{th}$ 87-order sector to investment in the $k^{th}$ 53 order sector of which the $i^{th}$ sector is a part.

The physical rate of depreciation, dep, and the present value of tax depreciation, z, depend upon the average service life of capital purchased by industry and the average tax life used by industry for computing the depreciation stream, respectively. The average tax lives are weighted averages of the tax lives constructed for the INFORUM model. The tax lives reflect the changing composition of the equipment purchased by industry as well as the changing tax laws.[6] The lives used to compute the physical rate of depreciation are those used for computing z without the adjustment for the changing tax laws.[7]

While the physical depreciation rate depends upon the average service life of capital, the actual form of the relationship must be one which is consistent with the method used to compute the capital stock. As we saw in Chapter 3, the method of computing the depreciation of equipment and, hence, the capital stock, depends upon two sets of parameters: the "weights" on the three depreciation streams and the "spill" rates used to construct the buckets from which the depreciation streams are derived. The set of weights are determined in the estimation of the equations subject to the linear restriction that they sum to unity. The spill rates are chosen based upon the assumed average service life of the equipment and are identical to the depreciation rate which appears in the user cost of capital.

To see why it is desirable for the spill rate so chosen and the depreciation rate which enters the usercost to be the same, assume that the average service life is given by $L^*$, and the weights are picked so that $d_1 = d_2 = 0$ and $d_3 = 1$. The depreciation is, then, given by

$$D(t) = (1-\lambda/1-\lambda L)^3 \; I_t$$

where L is the lag operator. We, therefore, wish the average service life, $L^*$, to equal the mean of the lag distribution $(1-\lambda)^3/(1-\lambda L)^3$, since both represent the length of time, on average, that it takes for equipment to fully depreciate. The mean lag is determined by taking the derivative of the lag polynominal and evaluating it at $L = 1$. Doing this gives the average service life, $L^*$, expressed in terms of the rate of retention, $\lambda$ , as

$$L^* = 3\lambda/(1-\lambda)$$

The rate of retention in terms of the average service life is then given by

$$\lambda = L^*/(L^*+3)$$

and the rate of depreciation which enters the usercost (and the spill rate used to compute the capital stock) becomes

$$\boxed{1-\lambda = dep = 3/(L^*+3)}$$

Since depreciation is computed by assuming a particular vector of d's, $L^*$ actually represents the upper bound of possible average lives. With $d_1$ and $d_2$ greater than zero, the implied average service life would be shorter that $L^*$.

The real rate of interest is defined as the nominal rate of interest minus the expected rate of inflation. The problem of constructing a real rate series, therefore, is one of finding the appropriate expression for the expected rate of inflation. Typically, expected inflation is represented by a weighted average of present and past inflation rates; consequently, the problem becomes one of finding the appropriate weights on present and past rates of inflation which may be used to compute the expected rate of inflation. The computed expected rate of inflation may then, in turn, be subtracted from the nominal rate of interest to provide the expected real rate of discount.

To find appropriate weights, we reasoned that since the expected rate of inflation was to be compared to the nominal rate of interest, the weights should show inflation expectations as they are reflected in the nominal rate. So, the real rate of discount was derived from a regression equation relating the AAA bond rate to the growth rates in money, GNP and prices:

$$n_t = F(Q,M) + \sum_i v_i \underline{\Delta} P_{t-i}$$

where

$n_t$ = AAA bond rate

$F$ = a function of output, Q, and money, M2; and,

$\underline{\Delta}\ P_t$ = percentage change in the GNP price deflator.

F turned out to be a distributed lag on the M2-GNP ratio. The rationale for this variable was that it reflected, approximately, the degree of monetary stringency which in turn has a negative short run affect on the nominal rate of interest. The real rate is then given by

$$r_t = n_t - \sum_i \hat{v}_i \underline{\Delta} P_{t-i}$$

where $\hat{V}$'s are the estimated parameters from the regression equation. The regression results are reported in (1). They give a time series on real rates which show a positive trend over the history.

There were some difficulties with the real rate so derived. In the first place, the rate computed in this way measured the expected real rate of return for a particular year; and this properly belongs in the user cost only under the assumption of static expectations. Second, movement in the real rate changed significantly depending upon whether or not one required the nominal rate to eventually adjust fully to the rate of inflation. For this requirement, the sum of the weights on present and past inflation must be unity. Should this requirement not be imposed, the weights would tend to sum to a number considerably less than one.[8]

For these reasons, we choose to use a constant real rate of discount over the history, the rate chosen to be the average of the real rates computed by the procedures just described. The average real rate of interest used turned out to be .0257.[9]

### Capital Stock

As was described in the previous chapter, the final construction of the capital stock must await the final estimated parameters of the model. However, as may be seen in equation (19) of chapter 3, at least some approximate measure of capital must be used in order to estimate the investment equation. In order to do this, prior "guesses" at the d's were made in order to compute a first estimate of capital. A more detailed discussion of this procedure is found in the next chapter.

## Appendix A: Industry Titles

1 FARMS AGR. SERVICES,FORESTRY,FISHERY (1)
2 CRUDE PETROLEUM AND NATURAL GAS (4)
3 MINING (2,3,5)
4 CONSTRUCTION (6)
5 FOOD, TOBACCO (7)
6 TEXTILES (8)
7 KNITTING, HOSIERY (9)
8 APPAREL AND HOUSEHOLD TEXTILES (10)
9 PAPER (11)
10 PRINTING (12)
11 AGRICULTURE FERTILIZERS (13)
12 OTHER CHEMICALS (14)
13 PETROLEUM REFINING & FUEL OIL (15,16)
14 RUBBER AND PLASTIC PRODUCTS (17,18)
15 FOOTWEAR AND LEATHER (19)
16 LUMBER (20)
17 FUNITURE (21)
18 STONE,CLAY & GLASS (22)
19 IRON AND STEEL (23)
20 NON-FERROUS METALS (24,25)
21 METAL PRODUCTS (26)
22 ENGINES & TURBINS (27)
23 AGRICULTURE MACHINERY (28)
24 EMPTY
25 METALWORKING MACHINERY (30)
26 RESIDENTIAL
27 SPECIAL INDUCTRY MACHINERY (31)
28 MISC.NONELEC. MACHINERY (29,32)
29 COMPUTERS & OTHER OFFICE MACHINERY (33,34)
30 SERVICE INDUCTRY MACHINERY (35)
31 COMMUNICATIONS MACHINERY (36)
32 HEAVY ELECTRICAL MACHINERY (37)
33 HOUSEHOLD APPLIANCES (38)
34 ELECTRICAL LIGHTING & WIRING EQUIP (39)
35 RADIO,T.V.RECEIVING,PHONOGRAPH (40)
36 MOTOR VEHICLES (41)
37 AEROSPACE (42)
38 SHIPS & BOATS (43)
39 OTHER TRANSPORTATION EQUIP. (44)
40 INSTRUMENTS (45)
41 MISC. MFG. (46)
42 RAILROADS (47)
43 AIR TRANSPORT (50)
44 TRUCKING AND OTHER TRANSPORT (48,49,51,52)
45 COMMUNICATIONS SERVICES (53)
46 ELECTRIC UTILITIES (54)
47 GAS,WATER & SANITATION (55,56)
48 WHOLESALE & RETAIL TRADE (57,58)
49 FINANCE & INSURANCE (60)
50 REAL ESTATE (61)
51 HOTELS & REPAIRS MINUS AUTO (63)

52 BUSINESS SERVICES (64)
53 AUTO REPAIR (65)
54 MOVIES & AMUSEMENTS (66)
55 MEDICAL & ED. SERVICES (67)

## FOOTNOTES

1. Total current dollar investment is found in the various July *Surveys of Current Business* (SCB), table 5.6.
2. At the time this study was undertaken, BLS was in the process of compiling investment data through 1977.
3. The scaling lead to time series which looked very different from the ones originally provided in (4). This did not cause great concern since the accuracy of the BLS series could be easily questioned. The investment numbers were constructed from Internal Revenue Service publications on capital consumption and net depreciable assets. In some cases, this method lead to investment series which were unreasonably volatile even by investment data standards. For example, investment by REAL ESTATE AND RENTALS jumped from 77 million in 1965 to over one billion in 1966 in current dollars. Investment by AUTO REPAIR increased by almost 600 percent fom 1963 to 1964. (4) provides an extended discussion of the deficiencies of the IRS data.
4. The nonmanufacturing sectors are 1,4,42,43,44,45,48,49-55. See appendix A for title names. These data were compiled over the years by the INFORUM project. The main sources are various July issues of *SCB*.
5. Almon and Barbera (2) introduced into the user cost the ratio of debt to equity. It was reasoned that the form of financing affects the cost of capital services since the interest payment on debt is deductible from income while dividend payments to stockholders is not. The modification to the usercost proved to be of no major significance to the fits of the equations. Part ot the problem

could have been the poor measurement of debt and equity used in the study.

6. The tax lives through 1970 used for this study are based, primarily, upon the work undertaken by Mayor (6) with some minor modifications. A Chase Econometrics report (3) concludes that the 1962 change in the depreciation laws lowered the average tax lives for equipment by 20 percent across all industries. Thus, Mayor's pe 1962 data was adjusted slightly to agree with this recent conclusion. Since 1971, tax lives for equipment have been based upon the Asset Depreciation Range (ADR) system, which allows investors to choose tax lives within a range of 20 percent above or below the lives established in 1962 for each asset class. For this study, the assumption is made that the lower bound of the ADR system is selected, implying a further 20 percent drop in taxlives beginning in 1971. Finally, tax lives were not permitted to go below seven years, since should this occur, investors would forfeit the investment tax credit. We, therefore, assumed that investors chose to maintain eligibility for the tax credit, rather than write-off equipment at a faster rate. See (3) for further discussion.
7. Coen (5) found evidence that the 1962 *Guidelines* lives correspond best to the actual service lives of equipment. Thus, the service lives of equipment by industry are identical to the tax lives withoutthe adjustments prior to 1962 and beginning in 1971 due to changes in the tax laws.
8. The true nature of the "real" rate of interest depends upon the outcome of a number of controversies present in the literature.

Among the issues are the relationship between the nominal rate and the expected rate of inflation; the mechanism by which expectations are generated; and the relationship between the real rate of interest and stabilization policy.

9. We experimented with the real rate described in (1) as well as other real rates estimated along the lines outlined in this chapter. In addition, we tried various constant real rates as well as the one settled on. The empirical results were not significantly different in the various cases.

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5. Coen, R.M., "Investment Behavior, the Measurement of Depreciation, and Tax Policy," American Economic Review, March 1975, pp. 59-74.

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# Chapter 5

# Estimation

## 1. Introduction

The model described in Chapter 3 was estimated using the data outlined in Chapter 4 for 53 industries. A number of problems were encountered, however, which required alteration of the final form of the model described in Chapter 3. Some of the changes are simplifications which resulted from data limitations. Other changes were introduced in order to produce a forecasting model with dynamic and long run properties consistent with firmly established empirical findings of other studies. These modifications are discussed in the next section, followed by a description of the model actually estimated. In the third section, the estimates of the model incorporating the modifications discussed in section 2 is presented. It will be observed that the model cum priors does reasonably well at explaining factor demand over the history for most industries. It appears that the movement of energy prices played a significant role in explaining factor demand behavior over the past 25 years in a minority of industries. The final section offers some concluding remarks.

## 2. Problems of Estimation

The complete model described in Chapter 3 required the estimation of four factor demand equations -- investment, production workers, non-production workers, and energy for each industry. However, data on energy demand by industry do not exist at the present time.

Consequently, an energy demand equation could not be estimated in this study.

The method of constructing average hourly compensation for non-production workers described in Chapter 3 is but a crude approximation to the true measure by industry. It was hoped, nonetheless, that time series so constructed would be satisfactory enough to provide reasonable parameter estimates for the relationship between non-production workers on the one hand and production workers and capital on the other. The early attempts to use this data in a three equation model of capital, production workers, and non-production workers were not successful, however. These attempts led consistently, in a majority of industries, to results contrary to past empirical findings and one's own intuitive theoretical point of view. For example, the results seemed to show that non-production workers were a better substitute for capital than production workers in a majority of industries. In fact, production workers and capital showed up as complements in a majority of industries, while non-production workers and capital were strong substitutes in most industries. For the purposes of long term forecasting, it was felt that the simpler two equation model, which rested upon a firmer data base, would provide sufficient information. Consequently, the results presented in the next section are those of a two equation system explaining investment demand and the demand for aggregate labor employment per unit of output by industry.

The remaining changes imposed upon the model involved the use of prior information acquired through other empirical work or needed to make sense out of the empirical results. Thus, two separate sets of constraints were imposed upon the estimation process; one to assure our *a priori* pattern of response of capital and labor to the various input prices; and a second to assure that at all times depreciation of capital may never be negative.

Much debate has taken place over the past years about the degree of substitutability of labor and capital. Most of the debate has centered around the wisdom of using the Cobb-Douglas production function to model factor demand behavior. As is well known, such a function imposes a unitary elasticity of substitution between capital and labor. Such a function would, therefore, be an improper tool to use to determine, say, the impact of tax policy, which affects the user cost of capital, on investment behavior. However, those who have used the function counter with the argument that the preponderance of evidence supports the view that the long run elasticity of substitution is indeed unity. In particular, they point to the fact of the essentially constant income share of capital and labor over time. doesn't prove anything!

The studies which have supported this view have been estimated using data at the aggregate manufacturing level. However, estimating equations at the industry level leads to different conclusions. Studies done at a more disaggregated level tend to conclude that the elasticity of substitution in a majority of industries is somewhere between 0 and 1 but clearly less than 1.[1]

As the debate has raged, however, a general consensus appears to have developed that capital and labor are certainly not complements in production. In the studies ~~sighted~~ cited in Chapter 2 which made use of the translog cost/production function, all have found evidence of high substitutability between capital and labor at the aggregate level. Due to the problems mentioned in Chapter 2 of using the translog function, we believe these results tend to overstate the degree of substitutability between capital and labor. Nevertheless, these studies do contribute to the wealth of evidence suggesting at least non-complementarity between capital and labor.

With this evidence in mind, the model was estimated in such a way that capital and labor were not permitted to be complements in production. This implies that the elasticity of substitution between capital and labor ($ES_{KL}$) must be non-negative. If left unconstrained, only 21 of the 53 industries gave evidence of noncomplementarity between capital and labor. However, when so constrained, the deterioration in the fits were virtually imperceptible. Due to the shortage of data on energy demand by industry, as well as the questionable nature of both the employment and investment data for numerous industries, we were not compelled to question the capital-labor substitutability hypothesis based upon our unconstrained estimates. The constraint was, consequently, imposed.

The expression for the elasticity of substitution based upon the Diewert cost function includes relative prices, outputs and quantities of inputs for each year of the history. Consequently, the requirement that $ES_{KL}$ be non-negative would appear to lead to the imposition of one constraint for each year of the estimation period. However, this proves to be unnecessary since the sign of $ES_{KL}$ is completely determined by the sign of $b_{KL}$. We may see this by writing the elasticity of substitution as the ratio of the capital-labor cross price elasticity to labor's budget share.

$$ES_{KL} = .5 * (Q/K) * b_{KL} * (P_L/P_K)^{.5}/S_L \quad (1)$$

where

$Q$ = output

$P_E$ = price of energy input

$p_K$ = price of capital

$S_L$ = Labor's budget share.

Since all values are positive, restricting $ES_{KL}$ is identical to the requirement that $b_{KL}$ be greater than or equal to zero.

A second set of restrictions were imposed which assured that capital and labor responded inversely to changes in their own respective prices. If one is using a two-input production function, the fact of substitutibility between the inputs necessarily implies negative own price elasticities for each of the inputs. In the case of more than two factor production functions, this is not so, however. In terms of the Diewert cost function, for example, capital's own price elasticity is given by

$$E_{KK} = -.5 * (Q/K) * \{b_{KL} * (P_L/P_K)^{.5} + b_{KE} * (P_E/P_K)^{.5}\}$$

where K is the capital stock and the other variables are defined as in equation (1). A necessary requirement for $E_{KK} <= 0$ is the following:

$$b_{KL} * (P_L/P_K)^{.5} + b_{KE} * (P_E/P_K)^{.5} >= 0.$$

The negativity of own price elasticities through the history, therefore, would require a constraint for each year of the history. However, for practical reasons, we require only that the inequality hold at the 1977 values. The constraints may then be simply expressed by the following inequalities:

$$b_{LK} + b_{EK} >= 0; \quad b_{KL} + b_{EL} >= 0.$$

Imposing the restrictions in this way may allow for the possibility of positive own price elasticities at some point in the history. However, these elasticites will be small in absolute value; and, therefore, will not give equations which imply extremely perverse behavior.

No restrictions are placed upon the sign of the capital-energy and labor-energy cross price elasticities. Thus, energy may be either a complement or a substitute with capital and labor. As the discussion in Chapter 2 demonstrated, this issue is far from settled in the literature.

As we showed in Chapter 3, replacement investment is constructed partly by weights determined in the estimation process. As we argued then, the weights are required to sum to unity so that the total amount of equipment which depreciates is neither more nor less than the total equipment purchased. We found it necesary, however, to impose additional constraints upon these weights because attempts to estimate unconstrained weights, except that they sum to unity, gave results which implied unreasonable patterns of depreciation, and, in some cases, negative capital stocks. For example, often at least one of the unconstrained weights would be negative. If the first weight were negative, it would imply that depreciation early in the life of the equipment was actually negative. This would suggest that some equipment actually grows in productive capacity after it is installed and only after some lag does it begin to wear down. Negative values for the second and third weights lead to similar and unacceptable conclusions. Consequently, negative weights were viewed as unacceptable for purposes of forecasting.[2] Even without permitting negative weights, however, the range of depreciation patterns are far greater than those allowed in other studies.

An additional group of modifications involved specifying the distributed lags on changes in output and the various relative price variables. A search for the best lag structure for the independent variables began with an estimation of all lags without restrictions except those implied by the cost function. It was clear from the beginning that unconstrained lags would not give reasonable results. We therefore found it necessary to impose some structure on the distributed lags.

The distributed lag on the capital-labor relative price was allowed a length of up to four years without further constraints, except that each coefficient be positive, consistent with our elasticity restriction. This decision was based upon early experimentation in which OLS estimates clearly showed that the lag structures differed significantly from industry to industry. As noted in Chapter 3, the distributed lag on the capital-labor relative price in the investment equation is required to be identical to that in the productivity equation.

Instantaneous adjustment of labor requirements to the energy-labor relative price was required. The contemporaneous price proved superior to a broad range of lag structures tried. The lag structure on the energy-capital relative price was required to be a five-year moving average. Unconstrained OLS estimates tended to be U shaped and frequently changed signs. The chosen lag structure appeared to work best for the industry data, and conforms closely to our prior view that should the size of the optimal capital stock change in response to energy price changes, it would require an extended period of time for the complete adjustment to take place.

The lag on changes in output in the investment equation was allowed a maximum length of five years; lag weights were required to lie on a second degree polynomial, and to be declining in the fifth year. The pattern worked well in a previous study of investment behavior at the industry level using the CES production function.[3]

We chose, finally, to introduce an additional trend variable in the employment equation which begins in 1970 with the value of one. There were two reasons for allowing the trend growth in employment per unit of output to change in the estimation. First, a review of the data suggested that there was, indeed, a distinctive shift in the trend growth in productivity starting around 1970. Second, an earlier version of the model which allowed for a constant trend coefficient throughout the history generated what appeared to be unreasonably high labor-energy price elasticities. In effect, practically all of the slowdown in productivity growth which occurred since 1970 was attributed to higher energy prices. To be more confident with this result, we allowed for a modified trend in the 1970's to account for other influences on productivity which might have been improperly captured in the energy price variable. The energy price elasticities presented in the next section are significantly lower in absolute value than the same elasticities estimated with just one trend coefficient.

As may be seen from the regime of constraints which have been imposed upon the model to assure what we view as "reasonable" results, the approach to estimation in this study is clearly inconsistent with the attitude toward empirical work found in many publications. The methods used in this study follow from the objectives to which this study is directed and the purposes to which the model will be employed.

The objective of this study is to produce a long-term forecasting model while in most published empirical work the objective is hypothesis testing. To achieve our stated objective, a rather general theoretical model has been derived which might admit a multitude of empirical results when fitted to an existing body of data. However, in an effort to produce an acceptable forecasting model, there is no reason to limit the information used to estimate the model to the time series that has been constructed. There is a body of both theoretical and empirical work which has preceded this study which might provide useful information to be used in the estimation. All that is being sought is a model, combined with empirical findings by others generally accepted by economists, which might do a reasonable job of explaining employment and investment demand by industry in the history and give forecasts in which one might have confidence.

Based upon the modifications outlined in the preceding pages, the model actually estimated for this study is a restricted version of the one described in Chapter 3, and is displayed in equation system (2).

The presence of inequality constraints required the use of quadratic programming techniques to arrive at the parameter estimates. The program was supplied by the INFORUM project and adapted by this author for the present study.

$$I_t = \left(\frac{K}{Q^*}\right)_{t-1} \sum_{i=0}^{4} W_i \, \Delta \, Q_{t-i} + e^{-a_K t} \, Q_t \left\{ \sum_{i=0}^{3} \beta_i^{KL} \, \Delta \left(\frac{P_L}{P_K}\right)_{t-i} \quad b_{KE} \, \Delta \left(\frac{P_E}{P_K}\right)_t^{*.5} \right\}$$

$$- \, a_K K_{t-1} + \sum_{i=1}^{3} d_i \, D_i(t)$$

$$\left(\frac{L}{Q}\right)_t = e^{-a_1 t_1} \, e^{a_2 t_2} \left\{ \sum_{i=0}^{3} \beta_i^{LK} \left(\frac{P_K}{P_L}\right)_{t-i} + b_{LE} \left(\frac{P_E}{P_L}\right)^{.5} \right\} + \left(\frac{L}{Q}\right)^{*}_{t-1} * \sum_{i=0}^{3} V_i \, \Delta \, Q_{t-i}$$

where

$$\sum_{i=0}^{4} W_i = 1 \quad ;$$

$$W_i \geq 0 \quad i=0, \ldots 4 \quad ;$$

$$\beta_i^{KL} = \beta_i^{LK} \geq 0 \tag{2}$$

$$\sum_{i=0}^{3} V_i = 0$$

$$\sum_i d_i = 1$$

$$d_i \geq 0 \quad i=1, \ldots 3$$

and

$$Q^* = \sum_{i=0}^{3} Q_{t-i}/4$$

$$\Delta \left(\frac{P_E}{P_K}\right)_t^{*.5} = \sum_{i=0}^{4} \Delta \left(\frac{P_E}{P_K}\right)_{t-i}^{.5} /5$$

$$\left(\frac{L}{Q}\right)_t^{*} = \sum_{i=0}^{3} \left(\frac{L}{Q}\right)_{t-i} /4$$

$$K_t = B_1(t) + B_2(t) + B_3(t)$$

$$t_1 = t - 1946 \qquad t = 1947, \ldots 77$$

$$t_2 = \begin{cases} 0 & t < 1970 \\ t-1969 & t = 1970, \ldots 77 \end{cases}$$

## 3. Results

The history of the growth in average labor productivity may be usefully divided into a number of distinct episodes, as displayed in Table 1. One observes from this table elements of similarity in the historical pattern of productivity growth among many industries as well as considerable varibility of growth rates. The clearest example of the similarities is the breadth of the productivity slowdown which has occured since 1973. There are 14 industries in which productivity actually declined in absolute terms over the 1973-77 period, while a total of 40 industries show evidence of labor productivity growth since 1973 compared to the period from 1947 to 1973. In addition, in 34 industries, productivity growth was lower in the 1966-73 period compared to the earlier 1958-66 period.

The general pattern which emerges for most industries over the post-war period, therefore, is one in which productivity growth began to slow very slightly in the latter part of the 1960's and the earlier part of the 1970's, followed by a precipitous drop in productivity growth from 1973 on. The model tested in this study will attempt to explain this pervasive slowdown with essentially two groups of variables: movements in relative prices, energy-wage and capital-wage, and percentage changes in output which reflect the cyclical movements in productivity, which are, in addition, required to disappear in the long run. The model, however, provides a useful framework within which one might introduce specific variables for each industry which might help to explain the peculiar history of that industry.

The pattern found in many industries in clearly born out by the

ANNUAL RATES OF GROWTH IN AVERAGE LABOR PRODUCTIVITY

|  |  | 47-58 | 58-66 | 66-73 | 47-73 | 73-77 | 47-77 |
|---|---|---|---|---|---|---|---|
| 1 | FARMS AGR. SERVICES,FORESTRY,FISHERY | 5.5 | 6.1 | 3.4 | 5.0 | 3.5 | 4.9 |
| 2 | CRUDE PETROLEUM AND NATURAL GAS (4) | 1.8 | 5.7 | 3.1 | 3.4 | -11.7 | 1.4 |
| 3 | MINING (2,3,5) | 2.9 | 4.8 | 1.5 | 3.0 | -6.8 | 1.8 |
| 4 | CONSTRUCTION (6) | 4.7 | 2.1 | -2.2 | 2.3 | 0.8 | 1.9 |
| 5 | FOOD, TOBACCO (7) | 3.3 | 2.5 | 3.1 | 2.9 | 2.3 | 2.9 |
| 6 | TEXTILES (8) | 5.3 | 3.2 | 1.9 | 3.8 | 7.6 | 4.2 |
| 7 | KNITTING, HOSIERY (9) | 7.8 | 5.2 | 8.6 | 6.7 | 3.0 | 6.6 |
| 8 | APPAREL AND HOUSEHOLD TEXTILES (10) | 3.8 | 1.5 | 3.5 | 2.9 | 3.7 | 3.1 |
| 9 | PAPER (11) | 1.9 | 3.1 | 2.9 | 2.2 | 1.3 | 2.4 |
| 10 | PRINTING (12) | 1.9 | 2.0 | 1.6 | 1.7 | 0.9 | 1.7 |
| 11 | AGRICULTURE FERTILIZERS (13) | 5.0 | 5.5 | 2.1 | 4.0 | -0.6 | 3.7 |
| 12 | OTHER CHEMICALS (14) | 4.6 | 5.0 | 4.8 | 4.3 | 0.7 | 4.2 |
| 13 | PETROLEUM REFINING & FUEL OIL (15,16 | 4.6 | 5.3 | 2.0 | 4.0 | 5.5 | 4.3 |
| 14 | RUBBER AND PLASTIC PRODUCTS (17,18) | 3.4 | 3.1 | 4.0 | 3.2 | -0.8 | 2.9 |
| 15 | FOOTWEAR AND LEATHER (19) | 1.5 | -0.1 | 2.1 | 1.1 | 3.0 | 1.4 |
| 16 | LUMBER (20) | 3.7 | 2.5 | 2.8 | 3.2 | 2.9 | 3.1 |
| 17 | FUNITURE (21) | 2.7 | 1.5 | 2.8 | 2.3 | 2.0 | 2.3 |
| 18 | STONE,CLAY & GLASS (22) | 3.6 | 2.6 | 1.5 | 2.6 | 1.2 | 2.5 |
| 19 | IRON AND STEEL (23) | -1.1 | 2.2 | 2.0 | 0.4 | -1.8 | 0.4 |
| 20 | NON-FERROUS METALS (24,25) | 2.8 | 2.9 | 2.5 | 2.5 | -0.8 | 2.3 |
| 21 | METAL PRODUCTS (26) | 1.8 | 2.6 | 1.4 | 1.8 | 0.3 | 1.7 |
| 22 | ENGINES & TURBINS (27) | 3.6 | 3.4 | 5.7 | 3.7 | 2.1 | 3.8 |
| 23 | AGRICULTURE MACHINERY (28) | 2.5 | 1.9 | 3.5 | 2.3 | 4.5 | 2.8 |
| 25 | METALWORKING MACHINERY (30) | 2.4 | 1.9 | 0.9 | 1.5 | -0.8 | 1.5 |
| 27 | SPECIAL INDUCTRY MACHINERY (31) | 1.5 | 4.1 | 2.5 | 2.3 | -5.3 | 1.5 |
| 28 | MISC.NONELEC. MACHINERY (29,32) | 2.5 | 2.0 | 1.9 | 1.8 | -0.4 | 1.8 |
| 29 | COMPUTERS & OTHER OFFICE MACHINERY ( | 6.3 | 7.8 | 4.3 | 5.5 | 10.3 | 6.7 |
| 30 | SERVICE INDUCTRY MACHINERY (35) | 1.9 | 6.0 | 2.1 | 3.1 | 0.9 | 2.9 |
| 31 | COMMUNICATIONS MACHINERY (36) | 8.6 | 6.5 | 4.1 | 6.2 | 3.6 | 6.3 |
| 32 | HEAVY ELECTRICAL MACHINERY (37) | 0.6 | 4.5 | 2.5 | 2.0 | 1.5 | 2.2 |
| 33 | HOUSEHOLD APPLIANCES (38) | 1.3 | 3.9 | 5.0 | 2.7 | 2.6 | 3.0 |
| 34 | ELECTRICAL LIGHTING & WIRING EQUIP ( | 0.3 | 2.4 | 2.4 | 1.4 | 0.4 | 1.4 |
| 35 | RADIO,T.V.RECEIVING,PHONOGRAPH (40) | 6.5 | 7.8 | 4.6 | 5.8 | 9.8 | 6.8 |
| 36 | MOTOR VEHICLES (41) | 2.8 | 4.2 | 3.0 | 3.0 | 3.0 | 3.2 |
| 37 | AEROSPACE (42) | 9.9 | 3.4 | 2.8 | 5.5 | -1.6 | 5.0 |
| 38 | SHIPS & BOATS (43) | 4.0 | 1.8 | 3.2 | 2.7 | 0.6 | 2.8 |
| 39 | OTHER TRANSPORTATION EQUIP. (44) | -4.8 | 1.2 | 5.1 | -0.4 | 0.4 | -0.2 |
| 40 | INSTRUMENTS (45) | 2.1 | 3.8 | 5.5 | 3.2 | 2.4 | 3.4 |
| 41 | MISC. MFG. (46) | 4.4 | 3.5 | 3.3 | 3.8 | 3.1 | 3.7 |
| 42 | RAILROADS (47) | 2.0 | 5.9 | 4.0 | 3.4 | 0.4 | 3.3 |
| 43 | AIR TRANSPORT (50) | 6.3 | 5.7 | 3.4 | 5.0 | 1.4 | 4.8 |
| 44 | TRUCKING AND OTHER TRANSPORT (48,49, | -0.8 | 1.2 | 2.8 | 0.6 | 2.6 | 1.0 |
| 45 | COMMUNICATIONS SERVICES (53) | 6.2 | 5.1 | 3.9 | 5.0 | 7.0 | 5.5 |
| 46 | ELECTRIC UTILITIES (54) | 5.2 | 5.6 | 4.6 | 4.8 | 1.7 | 4.7 |
| 47 | GAS,WATER & SANITATION (55,56) | 4.3 | 4.7 | 1.0 | 3.6 | -2.1 | 2.8 |
| 48 | WHOLESALE & RETAIL TRADE (57,58) | 2.3 | 3.5 | 2.9 | 2.6 | 0.8 | 2.6 |
| 49 | FINANCE & INSURANCE (60) | 0.6 | 0.7 | 1.3 | 0.8 | -0.2 | 0.7 |
| 50 | REAL ESTATE (61) | 2.8 | 3.0 | -2.3 | 1.7 | 2.4 | 1.6 |
| 51 | HOTELS & REPAIRS MINUS AUTO (63) | 1.2 | 1.3 | 1.7 | 1.3 | -1.2 | 1.1 |
| 52 | BUSINESS SERVICES (64) | 1.6 | 0.1 | 1.6 | 1.3 | 1.1 | 1.1 |
| 53 | AUTO REPAIR (65) | 2.2 | 3.2 | 2.6 | 2.2 | -3.1 | 1.9 |
| 54 | MOVIES & AMUSEMENTS (66) | -1.7 | 0.8 | -1.6 | -0.8 | 2.6 | -0.4 |
| 55 | MEDICAL & ED. SERVICES (67) | 0.4 | 0.6 | 1.4 | 0.7 | 0.2 | 0.7 |
| 56 | TOTAL U.S. | 2.7 | 3.0 | 2.0 | 2.4 | 1.0 | 2.4 |

**TABLE 1**

aggregate growth rates. Productivity grew at a 1.0 percent annual rate in the 1973-77 period, down from 2.4 percent over the previous 25 year period. In addition, productivity growth slowed over the 1966-73 period to 2.0 percent, compared with 3.0 percent over the 1958-66 period.

Table 2 displays the growth rates of the capital-labor ratios (KL) for the 53 industries studied over selected period of the history. Capital for this table is measured as simply the sum of the three "buckets" described in Chapter 3. Consequently, the assumption is that $d_1 = d_2 = 0$ and $d_3 = 1$. One would expect that, in the long run, a higher growth rate in KL would be associated with a higher growth rate in average labor productivity. At the aggregate level, growth in KL slowed over the 1973-77 period to 3.5 percent compared with 4.0 percent over the 1947-73 period. There were 24 industries in which KL slowed during the same 1947-73 period compared with the earlier period. Threfore, the slowdown evident at the aggregate level is certainly not restricted to a small number of industries. In addition, the widespread slowdown in KL growth combined with the productivity growth slowdown of the same period would appear to conform to one's prior expectations of how these time series should be correlated.

However, the drop in productivity growth seems, at a glance, to be too large to be fully accounted for merely by the drop in the growth of KL. The rate of post-1973 growth in average labor productivity dropped by almost 60 percent at the aggregate level compared with the pre-1973 growth rates (from 2.4 percent to 1.0 percent), while KL growth drops by only 12.5 percent over the same period (from 4.0 to 3.5 percent). In addition, looking at individual industries gives a mixed response to the question of whether or not the decline in productivity growth may be

## ANNUAL RATES OF GROWTH IN THE CAPITAL-LABOR RATIO

| | | 47-58 | 58-66 | 66-73 | 47-73 | 73-77 | 47-77 |
|---|---|---|---|---|---|---|---|
| 1 | FARMS AGR. SERVICES,FORESTRY,FISHERY | 7.5 | 4.6 | 2.5 | 5.0 | 4.5 | 5.2 |
| 2 | CRUDE PETROLEUM AND NATURAL GAS (4) | 6.2 | 6.2 | 2.4 | 5.1 | -6.6 | 3.6 |
| 3 | MINING (2,3,5) | 13.3 | 2.7 | 3.0 | 7.0 | -2.1 | 6.0 |
| 4 | CONSTRUCTION (6) | 7.4 | 2.0 | 3.5 | 4.6 | 6.8 | 5.0 |
| 5 | FOOD, TOBACCO (7) | 6.1 | 4.0 | 4.2 | 4.6 | 3.6 | 4.8 |
| 6 | TEXTILES (8) | 9.6 | 2.1 | 3.6 | 5.4 | 4.5 | 5.5 |
| 7 | KNITTING, HOSIERY (9) | 4.4 | -2.0 | 5.6 | 2.4 | 4.2 | 2.9 |
| 8 | APPAREL AND HOUSEHOLD TEXTILES (10) | 5.0 | -0.4 | 3.1 | 2.8 | 3.5 | 2.9 |
| 9 | PAPER (11) | 5.7 | 2.5 | 2.8 | 3.8 | 4.5 | 4.0 |
| 10 | PRINTING (12) | 6.3 | 2.9 | 4.4 | 4.4 | 2.7 | 4.5 |
| 11 | AGRICULTURE FERTILIZERS (13) | 9.0 | 7.3 | 4.3 | 6.9 | 11.0 | 7.7 |
| 12 | OTHER CHEMICALS (14) | 5.6 | 1.9 | 2.7 | 3.6 | 4.8 | 3.8 |
| 13 | PETROLEUM REFINING & FUEL OIL (15,16 | 11.5 | 4.5 | 4.9 | 7.1 | 6.6 | 7.4 |
| 14 | RUBBER AND PLASTIC PRODUCTS (17,18) | 6.9 | 0.6 | 2.6 | 3.7 | 3.3 | 3.7 |
| 15 | FOOTWEAR AND LEATHER (19) | 6.4 | 1.5 | 7.1 | 4.7 | 4.4 | 5.0 |
| 16 | LUMBER (20) | 9.5 | 3.7 | 3.8 | 5.9 | 7.1 | 6.3 |
| 17 | FUNITURE (21) | 3.6 | -1.0 | 3.5 | 2.0 | 6.3 | 2.7 |
| 18 | STONE,CLAY & GLASS (22) | 7.3 | 2.8 | 2.4 | 4.5 | 5.7 | 4.8 |
| 19 | IRON AND STEEL (23) | 10.8 | 2.4 | 4.2 | 6.5 | 4.2 | 6.1 |
| 20 | NON-FERROUS METALS (24,25) | 10.2 | 0.8 | 4.5 | 5.8 | 4.2 | 5.5 |
| 21 | METAL PRODUCTS (26) | 4.8 | 0.1 | 2.9 | 2.9 | 4.8 | 3.1 |
| 22 | ENGINES & TURBINS (27) | 6.4 | 2.2 | 7.4 | 5.1 | 7.3 | 5.6 |
| 23 | AGRICULTURE MACHINERY (28) | 3.6 | -2.2 | 3.0 | 2.0 | 7.2 | 2.4 |
| 25 | METALWORKING MACHINERY (30) | 8.4 | -4.1 | 2.7 | 3.4 | 1.2 | 2.8 |
| 27 | SPECIAL INDUCTRY MACHINERY (31) | 6.0 | -1.2 | 4.5 | 3.5 | 3.8 | 3.4 |
| 28 | MISC.NONELEC. MACHINERY (29,32) | 6.7 | -0.5 | 4.7 | 4.0 | 5.5 | 4.2 |
| 29 | COMPUTERS & OTHER OFFICE MACHINERY ( | 7.2 | 1.6 | 5.0 | 4.8 | 4.4 | 4.8 |
| 30 | SERVICE INDUCTRY MACHINERY (35) | 4.9 | -2.0 | 2.2 | 2.0 | 6.8 | 2.7 |
| 31 | COMMUNICATIONS MACHINERY (36) | 5.0 | 0.6 | 8.0 | 4.3 | 5.1 | 4.5 |
| 32 | HEAVY ELECTRICAL MACHINERY (37) | 4.4 | -0.9 | 3.4 | 2.7 | 4.8 | 2.8 |
| 33 | HOUSEHOLD APPLIANCES (38) | 3.2 | -2.3 | 1.4 | 1.1 | 3.5 | 1.3 |
| 34 | ELECTRICAL LIGHTING & WIRING EQUIP ( | 4.5 | -1.3 | 3.5 | 2.4 | 4.9 | 2.8 |
| 35 | RADIO,T.V.RECEIVING,PHONOGRAPH (40) | 3.2 | 3.0 | 8.5 | 4.3 | 9.5 | 5.2 |
| 36 | MOTOR VEHICLES (41) | 10.3 | -0.9 | -0.5 | 4.2 | -0.4 | 3.3 |
| 37 | AEROSPACE (42) | 3.7 | 6.7 | 10.1 | 6.4 | 1.1 | 5.7 |
| 38 | SHIPS & BOATS (43) | 11.5 | 3.7 | 6.2 | 7.3 | 8.9 | 7.8 |
| 39 | OTHER TRANSPORTATION EQUIP. (44) | 3.5 | -7.0 | 7.2 | 1.1 | 4.8 | 1.7 |
| 40 | INSTRUMENTS (45) | 4.8 | 2.9 | 6.3 | 4.4 | 4.4 | 4.6 |
| 41 | MISC. MFG. (46) | 7.9 | 1.8 | 3.7 | 4.7 | 4.3 | 4.8 |
| 42 | RAILROADS (47) | 10.2 | 4.8 | 5.1 | 6.9 | 4.4 | 6.8 |
| 43 | AIR TRANSPORT (50) | 0.0 | 6.9 | 7.3 | 3.9 | 0.8 | 3.7 |
| 44 | TRUCKING AND OTHER TRANSPORT (48,49, | 5.6 | 0.7 | 5.2 | 3.7 | 7.6 | 4.5 |
| 45 | COMMUNICATIONS SERVICES (53) | 7.2 | 6.8 | 5.3 | 6.3 | 6.0 | 6.5 |
| 46 | ELECTRIC UTILITIES (54) | 14.3 | 4.8 | 3.7 | 8.1 | 3.1 | 7.8 |
| 47 | GAS,WATER & SANITATION (55,56) | 9.3 | 1.2 | -0.9 | 4.0 | 2.1 | 3.8 |
| 48 | WHOLESALE & RETAIL TRADE (57,58) | 3.6 | 2.1 | 3.6 | 2.8 | 4.2 | 3.3 |
| 49 | FINANCE & INSURANCE (60) | 4.3 | 4.5 | 6.0 | 4.4 | 4.4 | 4.8 |
| 50 | REAL ESTATE (61) | 6.9 | 3.8 | 0.1 | 4.0 | 5.3 | 4.3 |
| 51 | HOTELS & REPAIRS MINUS AUTO (63) | 7.9 | 3.8 | 7.1 | 5.8 | 4.2 | 6.1 |
| 52 | BUSINESS SERVICES (64) | 2.9 | 1.6 | 5.5 | 3.0 | 5.5 | 3.5 |
| 53 | AUTO REPAIR (65) | 7.2 | 4.3 | 4.2 | 5.2 | 0.6 | 4.8 |
| 54 | MOVIES & AMUSEMENTS (66) | 9.3 | 3.6 | -1.1 | 4.6 | 2.3 | 4.4 |
| 55 | MEDICAL & ED. SERVICES (67) | 3.4 | 2.1 | 1.7 | 2.4 | 1.2 | 2.4 |
| 56 | TOTAL U.S. | 6.3 | 2.1 | 3.2 | 4.0 | 3.5 | 4.1 |

**TABLE 2**

largely accounted for by a decline in the capital stock. As mentioned earlier, there are 14 industries in which productivity actually declined in absolute terms (negative growth rates) since 1973. Among those 14 industries, two show an absolute decline in KL as well, namely, CRUDE PETROLEUM AND NATURAL GAS (2) and MINING (3), while eight others exhibit a lower post 1973 growth rate in KL relative to the pre-1973 period. Consequently, among the 14 industries with the most severe declines in productivity growth, ten exhibit the "correct" positive correlation between KL growth and productivity growth. However, there remain four industries which exhibit declining productivity levels coincident with *increasing* KL growth. The most conspicuous of these is AGRICULTURE FERTILIZERS (11), in which the post-1973 growth rate in KL was 10.9 percent compared with a pre-1973 growth of 6.9 percent; while the productivity growth rate went from 4.0 percent during the 1947-73 period to -.6 percent during the 1973-77 period. Finally, of the remaining 26 industries in which productivity growth declined since 1973, only nine industries simultaneously experienced declining KL growth.

The negative correlations between movements in KL and movements in productivity appear in many industries over the 1966-73 period, as well. At the aggregate level, as mentioned earlier, productivity growth slowed during this period relative to the earlier period. KL actually begins to accelerate over the 1966-73 period, however, giving further evidence of a slight paradox in the historical data.

This cursory review of the data reveals a few useful results. First, even though there is broad similarity across industries with respect to the pattern of both productivity growth and KL growth, there remains significant differences between industries. During a period of broad decline in productivity, 1973-77, there were some 30 percent of the industries studied which showed faster growth in productivity, relative to the earlier periods. Furthermore, even in those cases where the broad patterns are similar, there remains significant differences in the magnitudes of the rates. Finally, one may observe the dissimilarities between both the patterns and magnitudes of KL and productivity growth compared with their corresponding aggregates. Much useful information is missed by looking only at aggregates.

Second, a simple two factor model of capital and labor clearly would not be adequate to explain the behavior of productivity, at least for the past 20 years. We see an abundance of evidence suggesting that declining capital formation, alone, may not explain the declining productivity growth that began, for a large number of industries, as early as the late 1960's and accelerated during the early 1970's. Consequently, our model includes relative energy prices as well as capital costs and labor compensation as among the independent variables.

The pattern of energy prices relative to other input costs is most striking over the history. As described in Chapter ~~5~~ 4, we have contructed energy price series for each industry which takes into consideration the composition of energy demand by type for each industry. Therefore, the series differ from industry to industry. Tables 3 and 4 display growth rates for energy-capital and energy-labor relative prices for selected sub-periods over the history for each industry. As we see, there was a dramatic change in energy prices relative to other input costs in the recent past. In all industries, the average growth rate in energy price relative to both the wage rate and capital cost was negative over the 1947-73 period. In addition,

## ANNUAL RATES OF GROWTH IN ENERGY-CAPITAL RELATIVE PRICE

| | | 47-58 | 58-66 | 66-73 | 47-73 | 73-77 | 47-77 |
|---|---|---|---|---|---|---|---|
| 1 | FARMS AGR. SERVICES,FORESTRY,FISHERY | -4.0 | -1.3 | 0.2 | -2.5 | 7.8 | -0.7 |
| 2 | CRUDE PETROLEUM AND NATURAL GAS (4) | -5.4 | -0.8 | -1.4 | -2.9 | 4.9 | -1.9 |
| 3 | MINING (2,3,5) | -5.2 | -1.1 | 1.6 | -2.2 | 7.0 | -0.9 |
| 4 | CONSTRUCTION (6) | -3.7 | -0.7 | 0.7 | -2.3 | 8.3 | -0.2 |
| 5 | FOOD, TOBACCO (7) | -4.3 | -1.0 | -0.5 | -2.3 | 7.3 | -1.0 |
| 6 | TEXTILES (8) | -5.5 | -1.6 | -1.9 | -3.2 | 1.4 | -2.7 |
| 7 | KNITTING, HOSIERY (9) | -4.3 | -1.2 | -0.3 | -2.4 | 7.5 | -1.0 |
| 8 | APPAREL AND HOUSEHOLD TEXTILES (10) | -5.3 | -1.0 | -0.7 | -2.8 | 5.5 | -1.6 |
| 9 | PAPER (11) | -5.1 | -1.3 | -0.2 | -2.7 | 7.6 | -1.2 |
| 10 | PRINTING (12) | -4.5 | -1.2 | -1.1 | -2.5 | 3.7 | -1.7 |
| 11 | AGRICULTURE FERTILIZERS (13) | -3.6 | -0.4 | -0.9 | -1.8 | 8.4 | -0.5 |
| 12 | OTHER CHEMICALS (14) | -5.2 | -1.4 | -0.2 | -3.0 | 7.5 | -1.3 |
| 13 | PETROLEUM REFINING & FUEL OIL (15,16 | -4.4 | -0.9 | 0.7 | -2.6 | 9.7 | -0.4 |
| 14 | RUBBER AND PLASTIC PRODUCTS (17,18) | -6.4 | -2.9 | -1.2 | -3.8 | 4.3 | -2.8 |
| 15 | FOOTWEAR AND LEATHER (19) | -4.6 | -1.0 | -0.7 | -2.5 | 4.5 | -1.5 |
| 16 | LUMBER (20) | -4.4 | -1.0 | 0.1 | -2.5 | 7.1 | -0.9 |
| 17 | FUNITURE (21) | -4.4 | -1.0 | -0.5 | -2.4 | 5.3 | -1.3 |
| 18 | STONE,CLAY & GLASS (22) | -3.1 | -0.3 | 0.2 | -1.4 | 8.2 | -0.1 |
| 19 | IRON AND STEEL (23) | -4.9 | -1.5 | 0.1 | -2.5 | 7.2 | -1.2 |
| 20 | NON-FERROUS METALS (24,25) | -4.5 | -1.3 | -0.9 | -2.5 | 4.2 | -1.7 |
| 21 | METAL PRODUCTS (26) | -4.7 | -1.1 | -0.8 | -2.5 | 5.0 | -1.6 |
| 22 | ENGINES & TURBINS (27) | -4.9 | -1.2 | -0.8 | -2.7 | 5.2 | -1.6 |
| 23 | AGRICULTURE MACHINERY (28) | -4.5 | -1.1 | -0.5 | -2.4 | 6.6 | -1.2 |
| 25 | METALWORKING MACHINERY (30) | -4.8 | -1.4 | -0.7 | -2.8 | 5.4 | -1.6 |
| 27 | SPECIAL INDUCTRY MACHINERY (31) | -4.8 | -1.3 | -0.7 | -2.7 | 4.7 | -1.6 |
| 28 | MISC.NONELEC. MACHINERY (29,32) | -4.5 | -1.4 | -0.2 | -2.5 | 6.4 | -1.2 |
| 29 | COMPUTERS & OTHER OFFICE MACHINERY ( | -3.9 | -0.6 | -0.1 | -1.9 | 6.7 | -0.7 |
| 30 | SERVICE INDUCTRY MACHINERY (35) | -4.2 | -1.0 | -0.0 | -2.3 | 7.3 | -0.8 |
| 31 | COMMUNICATIONS MACHINERY (36) | -4.0 | -1.2 | -0.8 | -2.3 | 5.0 | -1.3 |
| 32 | HEAVY ELECTRICAL MACHINERY (37) | -4.2 | -1.0 | -0.4 | -2.3 | 6.1 | -1.1 |
| 33 | HOUSEHOLD APPLIANCES (38) | -4.1 | -0.5 | -0.4 | -2.0 | 6.3 | -0.9 |
| 34 | ELECTRICAL LIGHTING & WIRING EQUIP ( | -4.4 | -1.2 | -1.2 | -2.5 | 4.0 | -1.7 |
| 35 | RADIO,T.V.RECEIVING,PHONOGRAPH (40) | -4.0 | -0.7 | -0.4 | -2.1 | 6.9 | -0.8 |
| 36 | MOTOR VEHICLES (41) | -4.5 | -0.9 | -0.6 | -2.4 | 5.9 | -1.3 |
| 37 | AEROSPACE (42) | -3.9 | -0.8 | -0.6 | -2.2 | 6.1 | -1.0 |
| 38 | SHIPS & BOATS (43) | -4.5 | -0.8 | -0.4 | -2.4 | 5.7 | -1.2 |
| 39 | OTHER TRANSPORTATION EQUIP. (44) | -4.3 | -0.7 | -0.5 | -2.2 | 6.1 | -1.1 |
| 40 | INSTRUMENTS (45) | -4.4 | -1.2 | 0.0 | -2.4 | 7.1 | -1.0 |
| 41 | MISC. MFG. (46) | -4.4 | -1.2 | -0.3 | -2.5 | 5.9 | -1.2 |
| 42 | RAILROADS (47) | -5.2 | -0.8 | 0.2 | -2.7 | 9.3 | -0.9 |
| 43 | AIR TRANSPORT (50) | -1.6 | -0.7 | 0.5 | -1.5 | 10.2 | 0.7 |
| 44 | TRUCKING AND OTHER TRANSPORT (48,49, | -5.5 | -1.3 | 0.6 | -3.0 | 12.4 | -0.6 |
| 45 | COMMUNICATIONS SERVICES (53) | -4.2 | -0.1 | -1.0 | -2.0 | 5.7 | -1.0 |
| 46 | ELECTRIC UTILITIES (54) | -5.1 | -1.2 | 2.4 | -2.1 | 12.0 | -0.0 |
| 47 | GAS,WATER & SANITATION (55,56) | -3.2 | -0.0 | -0.2 | -1.5 | 12.8 | 0.5 |
| 48 | WHOLESALE & RETAIL TRADE (57,58) | -4.0 | -0.3 | -0.1 | -1.9 | 6.7 | -0.7 |
| 49 | FINANCE & INSURANCE (60) | -2.7 | -1.3 | 3.4 | -1.3 | 17.8 | 1.8 |
| 50 | REAL ESTATE (61) | -3.0 | -0.9 | 2.6 | -1.4 | 19.9 | 1.9 |
| 51 | HOTELS & REPAIRS MINUS AUTO (63) | -2.4 | 0.3 | 0.4 | -0.9 | 14.1 | 1.2 |
| 52 | BUSINESS SERVICES (64) | -2.9 | -0.3 | 2.0 | -1.2 | 15.6 | 1.4 |
| 53 | AUTO REPAIR (65) | -3.5 | 0.5 | 0.8 | -1.4 | 13.9 | 0.9 |
| 54 | MOVIES & AMUSEMENTS (66) | -2.2 | 0.1 | 0.0 | -1.1 | 16.5 | 1.4 |
| 55 | MEDICAL & ED. SERVICES (67) | -3.6 | -0.8 | 0.0 | -1.8 | 6.8 | -0.6 |

**TABLE 3**

## ANNUAL RATES OF GROWTH IN ENERGY-LABOR RELATIVE PRICE

| | 47-58 | 58-66 | 66-73 | 47-73 | 73-77 | 47-77 |
|---|---|---|---|---|---|---|
| 1 FARMS AGR. SERVICES,FORESTRY,FISHERY | -1.3 | -7.1 | -3.6 | -3.8 | 8.3 | -2.1 |
| 2 CRUDE PETROLEUM AND NATURAL GAS (4) | 0.9 | -2.6 | -3.8 | -1.4 | 5.2 | -0.6 |
| 3 MINING (2,3,5) | -4.1 | -3.4 | -2.4 | -3.4 | 9.6 | -1.7 |
| 4 CONSTRUCTION (6) | -2.5 | -4.2 | -1.7 | -3.4 | 12.2 | -0.8 |
| 5 FOOD, TOBACCO (7) | -4.2 | -3.7 | -2.7 | -3.6 | 8.3 | -2.0 |
| 6 TEXTILES (8) | -3.1 | -3.6 | -3.7 | -3.3 | 6.0 | -2.2 |
| 7 KNITTING, HOSIERY (9) | -1.9 | -2.8 | -2.3 | -2.4 | 11.9 | -0.4 |
| 8 APPAREL AND HOUSEHOLD TEXTILES (10) | -1.2 | -2.2 | -2.0 | -1.7 | 7.8 | -0.5 |
| 9 PAPER (11) | -4.0 | -3.9 | -2.0 | -3.4 | 9.0 | -1.8 |
| 10 PRINTING (12) | -3.6 | -2.8 | -2.4 | -3.0 | 7.8 | -1.6 |
| 11 AGRICULTURE FERTILIZERS (13) | -4.2 | -2.8 | -2.4 | -3.2 | 7.4 | -1.9 |
| 12 OTHER CHEMICALS (14) | -4.7 | -3.4 | -1.7 | -3.7 | 7.5 | -2.0 |
| 13 PETROLEUM REFINING & FUEL OIL (15,16 | -4.4 | -2.9 | -0.2 | -3.3 | 7.8 | -1.4 |
| 14 RUBBER AND PLASTIC PRODUCTS (17,18) | -4.2 | -2.2 | -2.1 | -3.0 | 6.6 | -1.7 |
| 15 FOOTWEAR AND LEATHER (19) | -2.9 | -2.8 | -2.8 | -2.9 | 7.9 | -1.4 |
| 16 LUMBER (20) | -2.9 | -3.7 | -2.9 | -3.4 | 8.5 | -1.6 |
| 17 FUNITURE (21) | -3.3 | -2.7 | -1.9 | -2.6 | 7.3 | -1.4 |
| 18 STONE,CLAY & GLASS (22) | -4.3 | -3.2 | -2.0 | -3.2 | 8.4 | -1.8 |
| 19 IRON AND STEEL (23) | -4.8 | -2.9 | -2.6 | -3.5 | 6.7 | -2.3 |
| 20 NON-FERROUS METALS (24,25) | -4.5 | -3.1 | -3.3 | -3.5 | 4.3 | -2.7 |
| 21 METAL PRODUCTS (26) | -4.1 | -3.1 | -2.2 | -3.2 | 6.1 | -2.0 |
| 22 ENGINES & TURBINS (27) | -4.2 | -3.1 | -3.2 | -3.6 | 5.2 | -2.4 |
| 23 AGRICULTURE MACHINERY (28) | -3.9 | -4.0 | -3.4 | -3.8 | 6.1 | -2.5 |
| 25 METALWORKING MACHINERY (30) | -4.4 | -3.3 | -2.3 | -3.6 | 6.9 | -2.1 |
| 27 SPECIAL INDUCTRY MACHINERY (31) | -4.1 | -3.6 | -2.8 | -3.6 | 5.2 | -2.4 |
| 28 MISC.NONELEC. MACHINERY (29,32) | -4.0 | -2.9 | -2.3 | -3.3 | 6.8 | -1.8 |
| 29 COMPUTERS & OTHER OFFICE MACHINERY ( | -4.3 | -3.8 | -2.0 | -3.5 | 5.7 | -2.3 |
| 30 SERVICE INDUCTRY MACHINERY (35) | -3.9 | -3.2 | -2.3 | -3.4 | 8.4 | -1.7 |
| 31 COMMUNICATIONS MACHINERY (36) | -4.4 | -2.8 | -3.6 | -3.6 | 4.9 | -2.6 |
| 32 HEAVY ELECTRICAL MACHINERY (37) | -4.2 | -2.4 | -2.4 | -3.1 | 7.1 | -1.8 |
| 33 HOUSEHOLD APPLIANCES (38) | -3.9 | -2.6 | -2.5 | -3.0 | 7.8 | -1.7 |
| 34 ELECTRICAL LIGHTING & WIRING EQUIP ( | -4.1 | -3.0 | -3.8 | -3.4 | 5.2 | -2.5 |
| 35 RADIO,T.V.RECEIVING,PHONOGRAPH (40) | -4.1 | -2.2 | -3.7 | -3.2 | 6.5 | -2.1 |
| 36 MOTOR VEHICLES (41) | -5.4 | -3.0 | -3.6 | -4.0 | 5.2 | -2.9 |
| 37 AEROSPACE (42) | -4.5 | -4.3 | -3.0 | -4.1 | 5.7 | -2.7 |
| 38 SHIPS & BOATS (43) | -3.7 | -3.7 | -1.8 | -3.3 | 6.7 | -1.8 |
| 39 OTHER TRANSPORTATION EQUIP. (44) | -4.9 | -3.7 | -2.2 | -3.9 | 6.5 | -2.5 |
| 40 INSTRUMENTS (45) | -5.3 | -2.8 | -2.0 | -3.7 | 8.3 | -2.1 |
| 41 MISC. MFG. (46) | -3.5 | -2.8 | -2.2 | -3.1 | 8.0 | -1.5 |
| 42 RAILROADS (47) | -3.5 | -3.3 | -3.7 | -3.4 | 11.9 | -1.4 |
| 43 AIR TRANSPORT (50) | -2.5 | -5.0 | -3.4 | -4.1 | 10.0 | -1.7 |
| 44 TRUCKING AND OTHER TRANSPORT (48,49, | -2.5 | -4.2 | -2.0 | -3.2 | 12.7 | -0.8 |
| 45 COMMUNICATIONS SERVICES (53) | -3.4 | -4.6 | -4.9 | -4.0 | 2.8 | -3.3 |
| 46 ELECTRIC UTILITIES (54) | -4.0 | -4.6 | -0.6 | -3.4 | 12.2 | -1.2 |
| 47 GAS,WATER & SANITATION (55,56) | -4.0 | -2.9 | -1.9 | -3.1 | 11.1 | -1.2 |
| 48 WHOLESALE & RETAIL TRADE (57,58) | -2.3 | -3.7 | -3.0 | -2.9 | 7.0 | -1.6 |
| 49 FINANCE & INSURANCE (60) | -2.0 | -4.6 | -0.2 | -2.9 | 17.5 | 0.3 |
| 50 REAL ESTATE (61) | -1.6 | -4.5 | -1.3 | -2.9 | 16.9 | 0.1 |
| 51 HOTELS & REPAIRS MINUS AUTO (63) | -0.7 | -3.4 | -2.4 | -2.0 | 14.8 | 0.3 |
| 52 BUSINESS SERVICES (64) | -1.8 | -3.2 | -0.6 | -2.2 | 15.7 | 0.4 |
| 53 AUTO REPAIR (65) | -0.8 | -3.3 | -2.7 | -2.1 | 15.8 | 0.3 |
| 54 MOVIES & AMUSEMENTS (66) | -1.0 | -3.6 | -0.1 | -1.7 | 14.8 | 0.6 |
| 55 MEDICAL & ED. SERVICES (67) | -2.0 | -4.4 | -5.1 | -3.5 | 7.5 | -2.1 |

**TABLE 4**

energy prices relative to labor cost declined at a faster rate than did the energy-capital relative price. In 41 industries the energy-wage relative price declined an average of three percent or more over the 1947-73 period, while the energy-capital relative price declined at better than the three percent rate in only four industries. Consequently, prior to 1973, energy was becoming cheaper relative to labor cost and capital cost.

During the 1973-77 period, energy became more expensive relative to capital and labor in all industries. In addition, the increased cost of energy is most pronounced in the transportation, utilities, and service sectors. One certainly would expect that the dramatic change in the structure of prices occurring since 1973 would have some effect upon the investment and employment decisions by industry.

Table 3 and 4 also reveal that the dramatic turnabout in energy prices beginning in 1973 was preceded by a more modest yet clear change in the pattern of energy prices during the 1966-73 period. For, during this period, there was a clear slowdown in the decline of energy prices relative to the other input prices. The slowdown in the decline of energy cost relative to labor cost occurred in 41 of the 53 industries, while the decline in energy cost relative to capital cost occurred in 44 of the 53 industries.

The model displayed in (2) was used to explain the data which generated the KL and productivity growth rates used to construct Tables 1 and 2. The price data embodied in Tables 3 and 4 were used as explanatory variables. The parameter estimates and $R^2$ for each industry are displayed in Table A1 in Apendix A; and the elasticities computed from these parameters, evaluated at the 1977 values of the dependent and independent variables, are displayed in Table 5. Since quadratic programming was used to estimate the model in order to incorporate our prior views about the sign patterns of the elasticities, conventional approaches to assessing the "quality" of the models may not be applied; for this reason, standard errors are not displayed.

Referring to Table A1 in Appendix A, the number labeled RSQR gives the $R^2$ for the entire system, and may be negative. NIT represents the number of iterations required for convergence. DQ1 through DQ4 are the coefficients in the productivity equation on percentage changes in output, and provide information on the cyclical movements of productivity. The first result one observes from these coefficients is the fact that average labor productivity (ALP) is procyclical in a majority of industries, consistent with a similar macro phenomenon. That is, as output increases, ALP increases above its long run path; and as output decreases, ALP decreases. An example is found in LUMBER (16) in Table A1. The coefficient labeled DQ1 says that a one percent increase in output leads in the same period to a 13.8 percent decrease in labor per unit of output below its long run growth path, which in this study is explained by relative price movements and a time trend. Therefore, an increase in output leads to an increase in ALP above its long run growth path, by, as it turns out, slightly more than 13.8 percent. The coefficient labeled DQ2 suggest that the first period increase in output will lead to a further reduction in the next period in labor requirements of approximately 7.8 percent. Finally, DQ3 and DQ4 are positive, suggesting that any increase in productivity of a purely cyclical nature will disappear by the end of the business cycle. Increasing returns are found in 45 of the 53 industries displayed. The only industries which do not follow this pattern are HOTEL AND REPAIRS (51), AEROSPACE (37), FOOTWEAR AND LEATHER (15), AGRICULTURE FERTILIZERS (11), AGRICULTURE (1), FINANCE AND INSURANCE (49), OTHER TRANSPORTATION (39) COMMUNICATIONS SERVICES (45), and AGRICULTURE MACHINERY (23).

Again referring to Table A1, coefficients labeled D1, D2, and D3 are the weights which together imply patterns of depreciaton. They show industry level depreciation patterns which for 35 of the 53 industries differ from the geometrically declining pattern used in much empirical work. As we stated in Chapter 3, industries in which the estimated D1 is different from unity do not have geometrically declining patterns of depreciation. Using the estimated coefficients, patterns of depreciation are constructed and plotted in Appendix B at the end of the chapter for those industries which have patterns different from the geometric pattern. As one may see from the plots, there exists considerable diversity across industries.

TRENDE and TRENDE2 correspond to the trend coefficients $a_1$ and $a_2$ in (2). Consequently, a positive TRENDE2 means that the rate of decline in employment per unit of output is lower starting in 1970 compared with the pre-1970 period. This result in turn suggests that the trend growth the productivity has slowed starting in 1970.

Appendix C, at the end of the chapter, gives the plots of actual versus predicted investment and productivity for each of the 53 industries. These provide another view of the ability of the model to track investment and employment over the history.

Table 5 presents evidence of the substitution possibilities among the inputs as well as measures of fit and serial correlation. Looking at the first industry, AGRICULTURE,FORESTRY,FISHERY, and reading across the CAPITAL row, we observe, first, the elasticity of capital with respect to its own price, $P_K$. Then we see the elasticity of capital with respect to the price of labor, $P_L$, and the price of energy, $P_E$. The SIGMA column gives the Allen elasticity of substitution, the only elasticity which we were able to compute with the data in hand. This elasticity measures the percentage change in the capital labor ratio in response to a percentage change in the ratio of the price of labor to the price of capital, holding all other input prices an output constant. Next, we see the cost share column ,CSTSHR, which together with the capital-labor cross price elasticity gives the AES for capital and labor. FIT is the root mean squared error expressed as a percentage of the mean of the dependent variable. The smaller this number, the better the fit. The final column, RHO, is the coefficient of serial correlation and is used in the forecast.

Table 5 sheds light on the substitution possibilities between capital and energy. There are 16 industries in which capital and energy are substitutes. Among the industries most sensitive to energy prices in this way are AGRICULTURE (1), CONSTRUCTION (4), AGRICULTURE FERTILIZERS (11), OTHER CHEMICALS (12), PETROLEUM REFINING (13), AEROSPACE (37), and GAS,WATER AND SANITATION (47), all with cross price elasticites greater than 0.2. Of the remaining 9 industries in which capital and energy are substitutes, three have elasticities between 0.1 and 0.2, and the remainder have elasticities less than 0.1.

There are 37 industries which show evidence of varying degrees of capital-energy complementarity. The most sensitive among these industries are OTHER TRANSPORTATION (39) and RADIO, T.V. (35) with elasticities greater than 0.5 in absolute value. Of the remaining industries nine have elasticities greater than 0.2 while 26 have elasticities less than 0.1.

Table 5 also provides information about the relationship between labor and energy by industry. There are 19 industries in which labor and energy are substitues; that is, higher energy prices lead to more labor employment, and lower average labor productivity. Consequently, higher energy prices relative to the wage rate played a role in the productivity slowdown in the 1973-77 period in a minority of the industries. For those industries where labor and energy are substitutes, two have elasticities greater than 0.5, while twelve have elasticities between 0.1 and 0.5. The most sensitive of the 19 industries are CRUDE PETROLEUM (2), ENGINES & TURBINES (22), and RAILROADS (42).

There are 33 industries in which labor and energy are complements. Therefore, in these industries higher energy prices lead to reduced employment for a given level of output. Some of the industries which are most sensitive in this way are TEXTILES (6), IRON & STEEL (19), AGRICULTURE MACHINERY (23), and SERVICE INDUSTRY MACHINERY (30). Of the remaining 29 industries, 17 have elasticities greater than 0.1 in absolute value.

The attempt to estimate the labor-energy elasticity had led us to try two previous versions of the model before settling on (2). The first version consisted in estimating the employment equation with a single trend coefficient. Those results gave equations which suggested that energy prices played a major role in the productivity slowdown of the 1970's. With a constant exponential trend specification, 34 industry equations showed that labor and energy were substitutes in production. The elasticities for this version of the model are presented in Appendix D. A second version of the model modified the exponential trend coefficient with a slope dummy which was set equal to one from 1970 through 1977. The purpose of this modification was to permit the trend growth in labor per unit of output to change beginning in 1970. The affect on the estimates was to reduce the number of industries in which labor and energy appeared as good substitutes to 31, and reduce the size of the elasticities slightly. The elasticities for this version are displayed in Appendix E.

The results which we have presented in this chapter are for the third version of the model in which an additional trend is introduced which starts with the value of one in 1970. However, this third version gave employment price elasticities for COMPUTERS & OTHER OFFICE MACHINERY (29) and MOTOR VEHICLES (36) which were so large that the equations actually generated negative employment by 1983 when a preliminary forecast of the equations was made.[4] Consequently, the equations in Table 5 for these two sectors are results from estimating the second version of the model.

As mentioned earlier, own price elasticities of capital and labor are required to be non-positive, while the cross price elasticities between capital and labor are required to be non-negative. Nevertheless, the magnitudes of these elasticities supply some useful information. There are four industries in which capital's own price elasticity is greater than 0.5 in absolute value: AGRICULTURE (1), AGRICULTURE FERTILIZERS (11), AEROSPACE (37), and GAS,WATER AND SANITATION (47), while there are 18 industries where the same is true of labor's own price elasticity. In addition, of the 42 industries in which at least one of the own price elasticities is non-zero, 32 show labor's own price elasticity is larger in absolute value than capital's. There is, consequently, evidence that labor is more adjustable in production than is capital.

Finally, there are three industries in which the elasticity of substitution is zero, 28 in which it is between zero and .25, seven in which it is between .25 and 0.5; five in which it is between 0.5 and 1.0, and 10 in which it is greater than unity. The industries with the highest elasticities of substitution between capital and labor are KNITTING, HOSIERY (7), COMMUNICATIONS MACHINERY (31), HOUSEHOLD APPLIANCES (33), and RADIO,T.V. (35). There seems to be little evidence to support the Cobb-Douglas function at the industry level.

## 4. Summary

Efforts to apply the Dierwert cost function to time series data on investment and productivity for 53 industries which exhaust the U.S. economy have been fruitful. Even with prior restrictions on selected elasticities, based upon well established past empirical and theoretical work, the model fits historical data satisfactorily for a majority of industries; and gives price elasticity measures with, for the most part, reasonable magnitudes. These results suggest that a combination of cyclical phenomena, relative price movements and trend variables are sufficient to explain the slowdown in productivity that began in the late 1960's and picked up steam in the 1970's.

We see from the results that both labor employment and investment are indeed sensitive to relative price movements. Capital appears as a complement with energy in most industries as does labor. The results suggest, further, that capital and labor are substitutable in production in most industries. As mentioned before, only three industries show a zero elasticity of substitution between capital and labor, while a majority of the industries show elasticities considerably less that unity.

Experimentation with various modifications of the model presented in this chapter revealed that the capital-labor elasticities were, for the most part, unchanged from specification to specification. In addition, the capital-energy elasticities were invariant with respect to various versions of the model. However, the labor-energy elasticity was extremely sensitive to the introduction of the second trend variable in the employment equation. For example, we see from the results in this chapter that labor and energy are substitutes in 19 industries. When the model was run with just a single trend variable, $a_1$ in equation (2), evidence of labor- energy substitutability appeared in 32 industries.

At the beginning of this study, we stated that our hope was to estimate a model which (i) was theoretically consistent, (ii) fit industry data well, (iii) would be capable of addressing long term policy issues dealing with capital formation and productivity, and (iv) would be a useful forecasting tool. In addition, we expected the model to shed light on the causes of the productivity slowdown which has plagued the economy during the 1970's. It is clear from the results presented in this chapter that our hopes have been only partially fulfilled. The model does fit industry data well as the plots in Appendix C demonstrate. Also, the theoretical soundness of the model makes it useful for studying the effects of tax policies on capital formation and productivity. Whether it is a useful forecasting tool must await the next chapter. Finally, we must admit that the model sheds little light on the causes of the productivity slowdown of the 1970's. For, most of the productivity slowdown is captured in the second time trend, labeled TRENDE2 in Appendix A. Consequently, although we are able to fit the data, we continue to be unable to explain what economic variables, if any, were and are responsible for the slowdown. The only candidate variables, other than a time trend, which we introduced into the model which might provide some explanation for the productivity slowdown were relative prices -- capital-labor and energy-labor. Indeed, one version of the model gave support to the contention that energy prices played a major role in the slowdown. However, we do not suggest that these variables represent an exhaustive list. We continue to believe that the model is an adequate framework within which additional variables may be introduced which might in turn provide a further explanation of the productivity experiences of the 1970's.

Now we turn, in the next chapter, to look at the ability of the model to predict employment and investment over the latter part of the 1970's and early part of the 1980's.

## FOOTNOTES

1. See (1) and (2).
2. There are ranges of negative values for the weights which would permit reasonable depreciation patterns. For example, depreciation could continue to be positive should the second weight be negative and small. In addition, it might be reasonable in some cases to allow for negative depreciation early in the life of the equipment, suggesting that the equipment actually becomes more productive some time after its installation date. However, we could find no feasible way to allow for these possibilities while, at the same time, prevent unreasonable parameter estimates. Consequently, we settled for requiring that they all remain positive.
3. See (1). There was an additional modification to the output series before estimation commenced. From the actual output series, Q, we constructed a new output series defined as follows:

$$Y_t = \begin{cases} Q_t \text{ for } Q_t >= (1-d)*Q_{t-1} \\ (1-d)*Q_{t-1} \text{ otherwise} \end{cases}$$

where d is the same spill rate used to construct the buckets for the different industries. The effect of this transformation is to reduce the size of the drop in industry output which might appear in the equations. The rationale for using the transformed time series is that firms do not view a huge drop in output as a drop in permanent output; and, consequently, they do not revise downward their desired capital stocks by as much as the drop in output might suggest. Since we are using the same spill rate as we used for the capital stock series, we are suggesting that a huge drop in output will be viewed as a reduction in permanent output just to the extent that existing capital is depreciated.

4. For COMPUTERS AND OTHER OFFICE MACHINERY, the elasticity of labor with respect to the price capital,labor and energy were, respectively, 3.366, -2.561 and -0.805. For MOTOR VEHICLES, the same elasticities were 4.670, -1.713, and -2.957.

## REFERENCES

1. Almon, C., and Barbera, A., "Investment in Producer Durable Equipment," in Von Furstenberg, G., ed., _Capital, Efficiency, and Growth_, Cambridge, Mass.: Ballinger Publishing Co., 1980, pp. 461-556.

2. Mayor, T.H., "Equipment Expenditure by Input-Output Industries," _The Review of Economics and Statistics_, Cambridge, Mas.: Harvard University Press, February 1971, pp. 26-36.

```
SUMMARY STATISTICS FOR FACTOR DEMAND EQUATIONS

*************************************************************************

      1 FARMS AGR. SERVICES,FORESTRY,FISHERY

 RSQR =  0.769     NIT =   7

COEFFICIENT ESTIMATES

       DQ1       DQ2       DQ3       DQ4    TRENDE   TRENDE2       BLL       BEL
   -0.0118   -0.0245    0.0076    0.0287    0.0700    0.1007    0.0309   -0.0893

       BKL        D1        D2        D3       PEK    INTCPT    TRENDV
    0.1677    0.9271    0.0000    0.0729    0.2668   -2.0086    0.0000

*************************************************************************

      2 CRUDE PETROLEUM AND NATURAL GAS (4)

 RSQR =  0.181     NIT =   4

COEFFICIENT ESTIMATES

       DQ1       DQ2       DQ3       DQ4    TRENDE   TRENDE2       BLL       BEL
   -0.0449   -0.0722    0.2442   -0.1271    0.0256    0.0671   -0.0089    0.0192

       BKL        D1        D2        D3       PEK    INTCPT    TRENDV
    0.0000    0.0000    0.0000    1.0000    0.3265    0.5830    0.0300

*************************************************************************

      3 MINING (2,3,5)

 RSQR =  0.455     NIT =   7

COEFFICIENT ESTIMATES

       DQ1       DQ2       DQ3       DQ4    TRENDE   TRENDE2       BLL       BEL
   -0.1853   -0.0002    0.1195    0.0660    0.0280    0.0514   -0.0036    0.0147

       BKL        D1        D2        D3       PEK    INTCPT    TRENDV
    0.0135    1.0000    0.0000    0.0000    0.1692   -0.2713    0.0000

*************************************************************************

      4 CONSTRUCTION (6)

 RSQR =  0.910     NIT =   6

COEFFICIENT ESTIMATES

       DQ1       DQ2       DQ3       DQ4    TRENDE   TRENDE2       BLL       BEL
   -0.5361    0.1660    0.4970   -0.1269    0.0298    0.0820    0.0594   -0.0238

       BKL        D1        D2        D3       PEK    INTCPT    TRENDV
    0.0238    1.0000    0.0000    0.0000    0.1147   -0.3829    0.0000
```

```
SUMMARY STATISTICS FOR FACTOR DEMAND EQUATIONS

*************************************************************************

       5 FOOD, TOBACCO (7)

 RSQR =  0.902      NIT =    4

COEFFICIENT ESTIMATES

      DQ1      DQ2      DQ3      DQ4   TRENDE  TRENDE2      BLL      BEL
  -0.2133  -0.0188   0.0355   0.1967   0.0374   0.0185   0.0245  -0.0041

      BKL       D1       D2       D3      PEK   INTCPT   TRENDV
   0.0041   0.6870   0.0000   0.3130   0.0077  -0.1772   0.0000

*************************************************************************

       6 TEXTILES (8)

 RSQR =  0.834      NIT =    4

COEFFICIENT ESTIMATES

      DQ1      DQ2      DQ3      DQ4   TRENDE  TRENDE2      BLL      BEL
  -0.4091  -0.2534   0.2077   0.4548   0.0700   0.0703   0.0866  -0.1335

      BKL       D1       D2       D3      PEK   INTCPT   TRENDV
   0.1593   0.2537   0.0000   0.7463  -0.1592  -0.1446   0.0000

*************************************************************************

       7 KNITTING, HOSIERY (9)

 RSQR =  0.891      NIT =    5

COEFFICIENT ESTIMATES

      DQ1      DQ2      DQ3      DQ4   TRENDE  TRENDE2      BLL      BEL
  -0.1378   0.0547   0.0109   0.0722   0.0627   0.0000   0.0521   0.0121

      BKL       D1       D2       D3      PEK   INTCPT   TRENDV
   0.1119   0.5149   0.0000   0.4851  -0.1119  -0.0723   0.0000

*************************************************************************

       8 APPAREL AND HOUSEHOLD TEXTILES (10)

 RSQR =  0.871      NIT =    7

COEFFICIENT ESTIMATES

      DQ1      DQ2      DQ3      DQ4   TRENDE  TRENDE2      BLL      BEL
  -0.0226   0.0346  -0.2553   0.2434   0.0436   0.0364   0.0971  -0.0736

      BKL       D1       D2       D3      PEK   INTCPT   TRENDV
   0.0736   0.7042   0.0000   0.2958  -0.0736  -0.0817   0.0125
```

```
SUMMARY STATISTICS FOR FACTOR DEMAND EQUATIONS

*********************************************************************************

       9 PAPER (11)

 RSQR =  0.851      NIT =   4

COEFFICIENT ESTIMATES

      DQ1       DQ2       DQ3       DQ4    TRENDE   TRENDE2       BLL       BEL
  -0.2349   -0.0173    0.0971    0.1552    0.0257    0.0000    0.0198   -0.0013

      BKL        D1        D2        D3       PEK    INTCPT    TRENDV
   0.0111    0.5425    0.0000    0.4575   -0.0034    0.3155    0.0300

*********************************************************************************

      10 PRINTING (12)

 RSQR =  0.966      NIT =   8

COEFFICIENT ESTIMATES

      DQ1       DQ2       DQ3       DQ4    TRENDE   TRENDE2       BLL       BEL
  -0.2715   -0.0208    0.0212    0.2710    0.0390    0.0487    0.0562   -0.0510

      BKL        D1        D2        D3       PEK    INTCPT    TRENDV
   0.0510    0.6559    0.0000    0.3441   -0.0510   -0.0817    0.0000

*********************************************************************************

      11 AGRICULTURE FERTILIZERS (13)

 RSQR =  0.934      NIT =   5

COEFFICIENT ESTIMATES

      DQ1       DQ2       DQ3       DQ4    TRENDE   TRENDE2       BLL       BEL
   0.0139   -0.4788    0.1517    0.3133    0.0341    0.0351   -0.0139    0.0006

      BKL        D1        D2        D3       PEK    INTCPT    TRENDV
   0.0251    0.6006    0.0000    0.3994    0.4871    0.0125    0.0000

*********************************************************************************

      12 OTHER CHEMICALS (14)

 RSQR =  0.918      NIT =   6

COEFFICIENT ESTIMATES

      DQ1       DQ2       DQ3       DQ4    TRENDE   TRENDE2       BLL       BEL
  -0.3101   -0.0460    0.0169    0.3392    0.0405    0.0022    0.0251    0.0077

      BKL        D1        D2        D3       PEK    INTCPT    TRENDV
   0.0000    0.8212    0.0000    0.1788    0.3309   -0.1546    0.0300
```

```
SUMMARY STATISTICS FOR FACTOR DEMAND EQUATIONS

*************************************************************************

      13 PETROLEUM REFINING & FUEL OIL (15,16

 RSQR =  0.729     NIT =   8

COEFFICIENT ESTIMATES

      DQ1       DQ2       DQ3       DQ4    TRENDE   TRENDE2       BLL       BEL
  -0.2784   -0.1874    0.3357    0.1301    0.0458    0.0259    0.0033    0.0013

      BKL        D1        D2        D3       PEK    INTCPT    TRENDV
   0.0015    0.0000    0.0000    1.0000    0.0616    0.1669    0.0013

*************************************************************************

      14 RUBBER AND PLASTIC PRODUCTS (17,18)

 RSQR =  0.960     NIT =   4

COEFFICIENT ESTIMATES

      DQ1       DQ2       DQ3       DQ4    TRENDE   TRENDE2       BLL       BEL
  -0.0692   -0.0887    0.0707    0.0873    0.0306    0.0086   -0.0027    0.0264

      BKL        D1        D2        D3       PEK    INTCPT    TRENDV
   0.0232    0.0000    0.0000    1.0000   -0.0232    0.1638    0.0300

*************************************************************************

      15 FOOTWEAR AND LEATHER (19)

 RSQR =  0.904     NIT =   4

COEFFICIENT ESTIMATES

      DQ1       DQ2       DQ3       DQ4    TRENDE   TRENDE2       BLL       BEL
   0.2276    0.0419   -0.1297   -0.1398    0.0155    0.0000    0.0573   -0.0158

      BKL        D1        D2        D3       PEK    INTCPT    TRENDV
   0.0162    0.2861    0.0000    0.7139   -0.0043    0.0073    0.0000

*************************************************************************

      16 LUMBER (20)

 RSQR =  0.947     NIT =   4

COEFFICIENT ESTIMATES

      DQ1       DQ2       DQ3       DQ4    TRENDE   TRENDE2       BLL       BEL
  -0.1387   -0.0784    0.1221    0.0949    0.0391    0.0326    0.0442   -0.0223

      BKL        D1        D2        D3       PEK    INTCPT    TRENDV
   0.0223    0.1439    0.8562    0.0000   -0.0223   -0.0076    0.0000
```

```
SUMMARY STATISTICS FOR FACTOR DEMAND EQUATIONS

***************************************************************************

      17 FUNITURE (21)

 RSQR =  0.910     NIT =   6

COEFFICIENT ESTIMATES

      DQ1      DQ2      DQ3      DQ4   TRENDE  TRENDE2      BLL      BEL
  -0.0502  -0.2881   0.2337   0.1046   0.0216   0.0111  -0.0180  -0.0173

      BKL       D1       D2       D3      PEK   INTCPT   TRENDV
   0.0895   0.1154   0.0000   0.8846  -0.0895  -0.0328   0.0000

***************************************************************************

      18 STONE,CLAY & GLASS (22)

 RSQR =  0.733     NIT =   4

COEFFICIENT ESTIMATES

      DQ1      DQ2      DQ3      DQ4   TRENDE  TRENDE2      BLL      BEL
  -0.1372  -0.0596   0.0711   0.1257   0.0140   0.0077   0.0037  -0.0010

      BKL       D1       D2       D3      PEK   INTCPT   TRENDV
   0.0260   0.7843   0.0000   0.2157  -0.0260   0.1692   0.0282

***************************************************************************

      19 IRON AND STEEL (23)

 RSQR = -0.632     NIT =   4

COEFFICIENT ESTIMATES

      DQ1      DQ2      DQ3      DQ4   TRENDE  TRENDE2      BLL      BEL
  -0.1174  -0.0301   0.0517   0.0958   0.0221   0.0341   0.0159  -0.0179

      BKL       D1       D2       D3      PEK   INTCPT   TRENDV
   0.0179   1.0000   0.0000   0.0000  -0.0179   0.0997   0.0300

***************************************************************************

      20 NON-FERROUS METALS (24,25)

 RSQR =  0.494     NIT =  15

COEFFICIENT ESTIMATES

      DQ1      DQ2      DQ3      DQ4   TRENDE  TRENDE2      BLL      BEL
  -0.1458  -0.0953   0.1501   0.0911   0.0152   0.0162  -0.0114   0.0029

      BKL       D1       D2       D3      PEK   INTCPT   TRENDV
   0.0222   0.1427   0.0000   0.8573  -0.0222   0.1674   0.0300
```

```
SUMMARY STATISTICS FOR FACTOR DEMAND EQUATIONS

************************************************************************

      21 METAL PRODUCTS (26)

 RSQR =  0.912      NIT =   8

COEFFICIENT ESTIMATES

      DQ1      DQ2      DQ3      DQ4   TRENDE  TRENDE2      BLL      BEL
  -0.1291  -0.0811   0.1759   0.0343   0.0439   0.0588   0.0466  -0.0489

      BKL       D1       D2       D3      PEK   INTCPT   TRENDV
   0.0489   0.1057   0.8943   0.0000  -0.0489  -0.0771   0.0187

************************************************************************

      22 ENGINES & TURBINS (27)

 RSQR =  0.931      NIT =   5

COEFFICIENT ESTIMATES

      DQ1      DQ2      DQ3      DQ4   TRENDE  TRENDE2      BLL      BEL
  -0.0296  -0.1158  -0.0526   0.1979   0.0261   0.0000  -0.0367   0.0290

      BKL       D1       D2       D3      PEK   INTCPT   TRENDV
   0.0335   0.8197   0.0000   0.1803  -0.0335  -0.0097   0.0300

************************************************************************

      23 AGRICULTURE MACHINERY (28)

 RSQR =  0.676      NIT =   6

COEFFICIENT ESTIMATES

      DQ1      DQ2      DQ3      DQ4   TRENDE  TRENDE2      BLL      BEL
   0.0155  -0.0141   0.0926  -0.0940   0.0590   0.0557   0.0499  -0.1056

      BKL       D1       D2       D3      PEK   INTCPT   TRENDV
   0.1056   0.0000   1.0000   0.0000  -0.1056  -0.0803   0.0000
```

```
SUMMARY STATISTICS FOR FACTOR DEMAND EQUATIONS

************************************************************************

      25 METALWORKING MACHINERY (30)

 RSQR =  0.599     NIT =   5

COEFFICIENT ESTIMATES

      DQ1       DQ2       DQ3       DQ4    TRENDE   TRENDE2       BLL       BEL
  -0.0070   -0.0417    0.0278    0.0210    0.0000    0.0006   -0.0060    0.0031

      BKL        D1        D2        D3       PEK    INTCPT    TRENDV
   0.0277    1.0000    0.0000    0.0000   -0.0277   -0.1699    0.0197

************************************************************************

      27 SPECIAL INDUCTRY MACHINERY (31)

 RSQR =  0.614     NIT =  15

COEFFICIENT ESTIMATES

      DQ1       DQ2       DQ3       DQ4    TRENDE   TRENDE2       BLL       BEL
  -0.2916    0.0130    0.0192    0.2594    0.0628    0.0841    0.0481   -0.0857

      BKL        D1        D2        D3       PEK    INTCPT    TRENDV
   0.0980    1.0000    0.0000    0.0000   -0.0980   -0.0310    0.0300

************************************************************************

      28 MISC.NONELEC. MACHINERY (29,32)

 RSQR =  0.952     NIT =   5

COEFFICIENT ESTIMATES

      DQ1       DQ2       DQ3       DQ4    TRENDE   TRENDE2       BLL       BEL
  -0.1129    0.0238    0.0312    0.0579    0.0101    0.0006   -0.0146    0.0109

      BKL        D1        D2        D3       PEK    INTCPT    TRENDV
   0.0298    1.0000    0.0000    0.0000   -0.0298   -0.2526    0.0040
```

```
SUMMARY STATISTICS FOR FACTOR DEMAND EQUATIONS

**************************************************************************

      29 COMPUTERS & OTHER OFFICE MACHINERY (

 RSQR =  0.797     NIT =   6

COEFFICIENT ESTIMATES

      DQ1       DQ2       DQ3       DQ4    TRENDE   TRENDE2       BLL       BEL
  -0.1477    0.0160    0.0832    0.0485    0.0700    0.0139   -0.2810   -0.0667

      BKL        D1        D2        D3       PEK    INTCPT    TRENDV
   0.4516    0.0000    0.0000    1.0000   -0.4515   -0.0075    0.0300

**************************************************************************

      30 SERVICE INDUCTRY MACHINERY (35)

 RSQR =  0.879     NIT =  15

COEFFICIENT ESTIMATES

      DQ1       DQ2       DQ3       DQ4    TRENDE   TRENDE2       BLL       BEL
  -0.1963   -0.1312    0.1911    0.1365    0.0700    0.1213    0.0348   -0.0941

      BKL        D1        D2        D3       PEK    INTCPT    TRENDV
   0.1144    1.0000    0.0000    0.0000   -0.1144   -0.0727    0.0071

**************************************************************************

      31 COMMUNICATIONS MACHINERY (36)

 RSQR =  0.880     NIT =   7

COEFFICIENT ESTIMATES

      DQ1       DQ2       DQ3       DQ4    TRENDE   TRENDE2       BLL       BEL
  -0.0562   -0.1532    0.0764    0.1330    0.0700    0.0756   -0.0515   -0.2005

      BKL        D1        D2        D3       PEK    INTCPT    TRENDV
   0.3619    0.5111    0.4889    0.0000   -0.3619   -0.3792    0.0000

**************************************************************************

      32 HEAVY ELECTRICAL MACHINERY (37)

 RSQR =  0.854     NIT =   9

COEFFICIENT ESTIMATES

      DQ1       DQ2       DQ3       DQ4    TRENDE   TRENDE2       BLL       BEL
  -0.0515   -0.1973    0.2090    0.0398    0.0459    0.0521    0.0491   -0.1160

      BKL        D1        D2        D3       PEK    INTCPT    TRENDV
   0.1160    1.0000    0.0000    0.0000   -0.1160   -0.1213    0.0177
```

```
SUMMARY STATISTICS FOR FACTOR DEMAND EQUATIONS

*************************************************************************

      33 HOUSEHOLD APPLIANCES (38)

 RSQR =  0.462     NIT =  13

COEFFICIENT ESTIMATES

      DQ1      DQ2      DQ3      DQ4   TRENDE  TRENDE2      BLL      BEL
  -0.2318  -0.1062   0.1611   0.1769   0.0700   0.0893  -0.0090  -0.2550

      BKL       D1       D2       D3      PEK   INTCPT   TRENDV
   0.3302   0.7490   0.0000   0.2510  -0.3301  -0.1048   0.0166

*************************************************************************

      34 ELECTRICAL LIGHTING & WIRING EQUIP (

 RSQR =  0.902     NIT =   4

COEFFICIENT ESTIMATES

      DQ1      DQ2      DQ3      DQ4   TRENDE  TRENDE2      BLL      BEL
  -0.2013  -0.0644   0.1019   0.1637   0.0000   0.0024  -0.0363   0.0185

      BKL       D1       D2       D3      PEK   INTCPT   TRENDV
   0.0415   0.6206   0.0000   0.3794  -0.0415  -0.0235   0.0209

*************************************************************************

      35 RADIO,T.V.RECEIVING,PHONOGRAPH (40)

 RSQR =  0.886     NIT =  11

COEFFICIENT ESTIMATES

      DQ1      DQ2      DQ3      DQ4   TRENDE  TRENDE2      BLL      BEL
  -0.0510  -0.1435   0.0557   0.1387   0.0700   0.0525  -0.2089  -0.0775

      BKL       D1       D2       D3      PEK   INTCPT   TRENDV
   0.4113   0.0000   0.0000   1.0000  -0.3430  -0.0282   0.0000

*************************************************************************

      36 MOTOR VEHICLES (41)

 RSQR = -1.521     NIT =  15

COEFFICIENT ESTIMATES

      DQ1      DQ2      DQ3      DQ4   TRENDE  TRENDE2      BLL      BEL
  -0.1057  -0.0149   0.0417   0.0789   0.0483   0.0041   0.0077  -0.0124

      BKL       D1       D2       D3      PEK   INTCPT   TRENDV
   0.0256   1.0000   0.0000   0.0000  -0.0256  -1.6931   0.0300
```

```
SUMMARY STATISTICS FOR FACTOR DEMAND EQUATIONS

*************************************************************************

      37 AEROSPACE (42)

 RSQR =  0.225     NIT =  15

COEFFICIENT ESTIMATES

      DQ1      DQ2      DQ3      DQ4   TRENDE  TRENDE2      BLL      BEL
   0.0221   0.1019  -0.1869   0.0629   0.0434   0.0555   0.0388  -0.0001

      BKL       D1       D2       D3      PEK   INTCPT   TRENDV
   0.0014   1.0000   0.0000   0.0000   0.1763  -0.1631   0.0143

*************************************************************************

      38 SHIPS & BOATS (43)

 RSQR =  0.811     NIT =   7

COEFFICIENT ESTIMATES

      DQ1      DQ2      DQ3      DQ4   TRENDE  TRENDE2      BLL      BEL
  -0.0243  -0.0132  -0.0163   0.0538   0.0197   0.0000  -0.0122  -0.0018

      BKL       D1       D2       D3      PEK   INTCPT   TRENDV
   0.0617   0.4728   0.5272   0.0000   0.0161  -0.0096   0.0000

*************************************************************************

      39 OTHER TRANSPORTATION EQUIP. (44)

 RSQR =  0.434     NIT =   5

COEFFICIENT ESTIMATES

      DQ1      DQ2      DQ3      DQ4   TRENDE  TRENDE2      BLL      BEL
   0.0830  -0.0498   0.0069  -0.0401   0.0253   0.0000   0.0568  -0.0836

      BKL       D1       D2       D3      PEK   INTCPT   TRENDV
   0.0836   1.0000   0.0000   0.0000  -0.0836  -0.0534   0.0000

*************************************************************************

      40 INSTRUMENTS (45)

 RSQR =  0.974     NIT =   7

COEFFICIENT ESTIMATES

      DQ1      DQ2      DQ3      DQ4   TRENDE  TRENDE2      BLL      BEL
  -0.1276   0.0053  -0.0419   0.1642   0.0389   0.0000   0.0153  -0.0640

      BKL       D1       D2       D3      PEK   INTCPT   TRENDV
   0.1230   0.0000   0.0608   0.9392  -0.1229  -0.0042   0.0000
```

```
SUMMARY STATISTICS FOR FACTOR DEMAND EQUATIONS

**************************************************************************

      41 MISC. MFG. (46)

 RSQR =  0.855      NIT =    6

COEFFICIENT ESTIMATES

      DQ1      DQ2      DQ3      DQ4   TRENDE  TRENDE2      BLL      BEL
  -0.4044  -0.0309   0.1161   0.3192   0.0485   0.0444   0.0437  -0.0219

      BKL       D1       D2       D3      PEK   INTCPT   TRENDV
   0.0592   1.0000   0.0000   0.0000  -0.0592  -0.0061   0.0300

**************************************************************************

      42 RAILROADS (47)

 RSQR =  0.816      NIT =    5

COEFFICIENT ESTIMATES

      DQ1      DQ2      DQ3      DQ4   TRENDE  TRENDE2      BLL      BEL
  -0.1162  -0.0109   0.0020   0.1251   0.0302   0.0107  -0.0512   0.0380

      BKL       D1       D2       D3      PEK   INTCPT   TRENDV
   0.0695   0.7480   0.0000   0.2520  -0.0203  -0.0151   0.0158

**************************************************************************

      43 AIR TRANSPORT (50)

 RSQR =  0.884      NIT =    4

COEFFICIENT ESTIMATES

      DQ1      DQ2      DQ3      DQ4   TRENDE  TRENDE2      BLL      BEL
  -0.4030   0.2441   0.2576  -0.0987   0.0184   0.0119  -0.0297   0.0116

      BKL       D1       D2       D3      PEK   INTCPT   TRENDV
   0.0446   0.6918   0.0000   0.3082  -0.0446  -0.0805   0.0300

**************************************************************************

      44 TRUCKING AND OTHER TRANSPORT (48,49,

 RSQR =  0.900      NIT =    3

COEFFICIENT ESTIMATES

      DQ1      DQ2      DQ3      DQ4   TRENDE  TRENDE2      BLL      BEL
  -0.0806  -0.0209  -0.0627   0.1642   0.0180   0.0000   0.0460  -0.0132

      BKL       D1       D2       D3      PEK   INTCPT   TRENDV
   0.0132   1.0000   0.0000   0.0000  -0.0132  -0.3768   0.0000
```

```
SUMMARY STATISTICS FOR FACTOR DEMAND EQUATIONS

*************************************************************************

      45 COMMUNICATIONS SERVICES (53)

 RSQR =  0.911     NIT =   5

COEFFICIENT ESTIMATES

      DQ1      DQ2      DQ3      DQ4   TRENDE  TRENDE2      BLL      BEL
   0.0342   0.0941  -0.1718   0.0434   0.0557   0.0197   0.1000  -0.0230

      BKL       D1       D2       D3      PEK   INTCPT   TRENDV
   0.0230   0.4002   0.0000   0.5998  -0.0230   0.8147   0.0300

*************************************************************************

      46 ELECTRIC UTILITIES (54)

 RSQR =  0.867     NIT =   6

COEFFICIENT ESTIMATES

      DQ1      DQ2      DQ3      DQ4   TRENDE  TRENDE2      BLL      BEL
  -0.2682   0.1040   0.1290   0.0352   0.0491   0.0184   0.0219   0.0053

      BKL       D1       D2       D3      PEK   INTCPT   TRENDV
   0.0091   0.0000   0.0000   1.0000  -0.0091   1.0124   0.0300

*************************************************************************

      47 GAS,WATER & SANITATION (55,56)

 RSQR =  0.217     NIT =   5

COEFFICIENT ESTIMATES

      DQ1      DQ2      DQ3      DQ4   TRENDE  TRENDE2      BLL      BEL
  -0.3262   0.0271   0.1491   0.1500   0.0333   0.0396   0.0043   0.0044

      BKL       D1       D2       D3      PEK   INTCPT   TRENDV
   0.0000   0.6823   0.0000   0.3177   0.1908  -0.3018   0.0000

*************************************************************************

      48 WHOLESALE & RETAIL TRADE (57,58)

 RSQR =  0.975     NIT =   5

COEFFICIENT ESTIMATES

      DQ1      DQ2      DQ3      DQ4   TRENDE  TRENDE2      BLL      BEL
  -0.2064  -0.0336   0.0940   0.1461   0.0226   0.0058   0.0464   0.0324

      BKL       D1       D2       D3      PEK   INTCPT   TRENDV
   0.0339   1.0000   0.0000   0.0000   0.0184  -1.3683   0.0044
```

```
SUMMARY STATISTICS FOR FACTOR DEMAND EQUATIONS

*************************************************************************

      49 FINANCE & INSURANCE (60)

 RSQR =  0.973     NIT =   5

COEFFICIENT ESTIMATES

       DQ1       DQ2       DQ3       DQ4    TRENDE   TRENDE2       BLL       BEL
    0.0142   -0.0286    0.0467   -0.0323    0.0052    0.0000    0.0368   -0.0037

       BKL        D1        D2        D3       PEK    INTCPT    TRENDV
    0.0039    1.0000    0.0000    0.0000   -0.0039   -0.0105    0.0000

*************************************************************************

      50 REAL ESTATE (61)

 RSQR =  0.833     NIT =   5

COEFFICIENT ESTIMATES

       DQ1       DQ2       DQ3       DQ4    TRENDE   TRENDE2       BLL       BEL
   -0.4118   -0.0391    0.2097    0.2412    0.0228    0.0928   -0.0002   -0.0062

       BKL        D1        D2        D3       PEK    INTCPT    TRENDV
    0.0150    1.0000    0.0000    0.0000    0.0250   -0.4388    0.0000

*************************************************************************

      51 HOTELS & REPAIRS MINUS AUTO (63)

 RSQR =  0.890     NIT =   5

COEFFICIENT ESTIMATES

       DQ1       DQ2       DQ3       DQ4    TRENDE   TRENDE2       BLL       BEL
    0.1258    0.0235    0.0983   -0.2476    0.0159    0.0085    0.1050   -0.0105

       BKL        D1        D2        D3       PEK    INTCPT    TRENDV
    0.0106    1.0000    0.0000    0.0000    0.0602    0.0631    0.0000

*************************************************************************

      52 BUSINESS SERVICES (64)

 RSQR =  0.986     NIT =   4

COEFFICIENT ESTIMATES

       DQ1       DQ2       DQ3       DQ4    TRENDE   TRENDE2       BLL       BEL
   -0.1618    0.0872   -0.0321    0.1067    0.0108    0.0000    0.0365   -0.0041

       BKL        D1        D2        D3       PEK    INTCPT    TRENDV
    0.0041    0.7061    0.0000    0.2939   -0.0041   -0.1226    0.0000
```

```
SUMMARY STATISTICS FOR FACTOR DEMAND EQUATIONS

************************************************************************

      53 AUTO REPAIR (65)

 RSQR =  0.906     NIT =   3

COEFFICIENT ESTIMATES

      DQ1       DQ2       DQ3       DQ4    TRENDE   TRENDE2       BLL       BEL
 -0.2827    0.0141    0.1583    0.1104    0.0231    0.0119    0.0131    0.0112

     BKL        D1        D2        D3       PEK    INTCPT    TRENDV
  0.0071    1.0000    0.0000    0.0000   -0.0071   -0.0006    0.0300

************************************************************************

      54 MOVIES & AMUSEMENTS (66)

 RSQR =  0.769     NIT =   7

COEFFICIENT ESTIMATES

      DQ1       DQ2       DQ3       DQ4    TRENDE   TRENDE2       BLL       BEL
 -0.2021   -0.1692    0.2318    0.1395    0.0000    0.0169    0.0418   -0.0123

     BKL        D1        D2        D3       PEK    INTCPT    TRENDV
  0.0123    0.0861    0.0000    0.9139    0.6092    0.5160    0.0300

************************************************************************

      55 MEDICAL & ED. SERVICES (67)

 RSQR =  0.974     NIT =   6

COEFFICIENT ESTIMATES

      DQ1       DQ2       DQ3       DQ4    TRENDE   TRENDE2       BLL       BEL
 -0.4004    0.2214   -0.0013    0.1802    0.0000    0.0038    0.0145    0.0129

     BKL        D1        D2        D3       PEK    INTCPT    TRENDV
  0.0249    0.6343    0.0000    0.3657    0.1596    0.5355    0.0300
```

# Appendix B: Patterns of Depreciation

```
DEPRECIATION PATTERN FOR SECTOR NUMBER        1  - FARMS AGRICULTURE

DATE  DEP      D1
       IS *     IS +   IS      *         *         *         *         *
 48     0.09     0.10     0.00                                        *   +
 49     0.08     0.09     0.00                                    *  +
 50     0.08     0.08     0.00                                *  +
 51     0.07     0.07     0.00                             * +
 52     0.06     0.07     0.00                          * +
 53     0.06     0.06     0.00                       * +
 54     0.05     0.05     0.00                    * +
 55     0.05     0.05     0.00                  *+
 56     0.04     0.04     0.00                *+
 57     0.04     0.04     0.00              *+
 58     0.03     0.03     0.00             +
 59     0.03     0.03     0.00           *+
 60     0.03     0.03     0.00          +
 61     0.03     0.03     0.00         +
 62     0.02     0.02     0.00        +
 63     0.02     0.02     0.00       +
 64     0.02     0.02     0.00      +
 65     0.02     0.02     0.00     +
 66     0.02     0.02     0.00    +*
 67     0.01     0.01     0.00    +
 68     0.01     0.01     0.00   +
 69     0.01     0.01     0.00  +*
 70     0.01     0.01     0.00  +
 71     0.01     0.01     0.00 +*
 72     0.01     0.01     0.00 +*
 73     0.01     0.01     0.00 +
 74     0.01     0.01     0.00+*
 75     0.01     0.01     0.00+*
 76     0.01     0.01     0.00+
 77     0.01     0.00     0.00+
       IS *     IS +   IS      *         *         *         *         *
                             0.005     0.026     0.048     0.070     0.091
```

NOTE:

* represents the depreciation pattern for industry

\+ represents the geometrically declining depreciation pattern

Spill rate is assumed to be 0.1 for all industries

```
DEPRECIATION PATTERN FOR SECTOR NUMBER        2  -  PETROLEUM & NATURAL GAS

DATE  DEP      D1
       IS *     IS +   IS     *         *         *         *         *
 48     0.00     0.10     0.00*                                           +
 49     0.00     0.09     0.00*                                      +
 50     0.00     0.08     0.00*                                  +
 51     0.00     0.07     0.00 *                              +
 52     0.00     0.07     0.00  *                         +
 53     0.01     0.06     0.00   *                     +
 54     0.01     0.05     0.00    *                  +
 55     0.01     0.05     0.00     *               +
 56     0.01     0.04     0.00      *           +
 57     0.02     0.04     0.00       *         +
 58     0.02     0.03     0.00        *      +
 59     0.02     0.03     0.00         *   +
 60     0.02     0.03     0.00          * +
 61     0.02     0.03     0.00          *+
 62     0.03     0.02     0.00          +*
 63     0.03     0.02     0.00         + *
 64     0.03     0.02     0.00        +   *
 65     0.03     0.02     0.00       +    *
 66     0.03     0.02     0.00      +     *
 67     0.03     0.01     0.00     +      *
 68     0.03     0.01     0.00     +      *
 69     0.03     0.01     0.00    +       *
 70     0.03     0.01     0.00    +       *
 71     0.03     0.01     0.00   +        *
 72     0.03     0.01     0.00   +       *
 73     0.03     0.01     0.00   +       *
 74     0.03     0.01     0.00  +        *
 75     0.03     0.01     0.00  +        *
 76     0.02     0.01     0.00  +       *
 77     0.02     0.00     0.00  +       *
       IS *     IS +   IS     *         *         *         *         *
                            0.000     0.023     0.045     0.068     0.091
```

```
DEPRECIATION PATTERN FOR SECTOR NUMBER        5  -  FOOD, TOBACCO

DATE  DEP      D1
       IS *     IS +    IS      *         *         *         *         *
 48     0.07     0.10     0.00                             *              +
 49     0.06     0.09     0.00                          *            +
 50     0.06     0.08     0.00                       *           +
 51     0.05     0.07     0.00                     *         +
 52     0.05     0.07     0.00                   *        +
 53     0.04     0.06     0.00                 *       +
 54     0.04     0.05     0.00                *     +
 55     0.04     0.05     0.00              *    +
 56     0.03     0.04     0.00             *   +
 57     0.03     0.04     0.00            *  +
 58     0.03     0.03     0.00           * +
 59     0.03     0.03     0.00          * +
 60     0.03     0.03     0.00          +
 61     0.03     0.03     0.00         +
 62     0.02     0.02     0.00        +
 63     0.02     0.02     0.00       +*
 64     0.02     0.02     0.00      +*
 65     0.02     0.02     0.00     + *
 66     0.02     0.02     0.00    + *
 67     0.02     0.01     0.00    + *
 68     0.02     0.01     0.00   + *
 69     0.02     0.01     0.00  +  *
 70     0.02     0.01     0.00  +  *
 71     0.01     0.01     0.00 +  *
 72     0.01     0.01     0.00 +  *
 73     0.01     0.01     0.00 + *
 74     0.01     0.01     0.00+  *
 75     0.01     0.01     0.00+  *
 76     0.01     0.01     0.00+  *
 77     0.01     0.00     0.00+ *
       IS *     IS +    IS      *         *         *         *         *
                             0.005     0.026     0.048     0.070     0.091
```

```
DEPRECIATION PATTERN FOR SECTOR NUMBER        6  - TEXTILES

DATE  DEP      D1
       IS *     IS +   IS     *         *         *         *         *
 48     0.03     0.10     0.00         *                                  +
 49     0.02     0.09     0.00        *                              +
 50     0.02     0.08     0.00       *                           +
 51     0.02     0.07     0.00       *                       +
 52     0.02     0.07     0.00       *                    +
 53     0.02     0.06     0.00       *                 +
 54     0.02     0.05     0.00       *              +
 55     0.02     0.05     0.00       *           +
 56     0.02     0.04     0.00       *         +
 57     0.02     0.04     0.00        *      +
 58     0.02     0.03     0.00        *    +
 59     0.02     0.03     0.00        *   +
 60     0.02     0.03     0.00         *+
 61     0.02     0.03     0.00         +
 62     0.02     0.02     0.00        +*
 63     0.03     0.02     0.00       + *
 64     0.03     0.02     0.00      +  *
 65     0.03     0.02     0.00     +   *
 66     0.02     0.02     0.00    +    *
 67     0.02     0.01     0.00    +    *
 68     0.02     0.01     0.00   +     *
 69     0.02     0.01     0.00  +     *
 70     0.02     0.01     0.00  +     *
 71     0.02     0.01     0.00 +      *
 72     0.02     0.01     0.00 +      *
 73     0.02     0.01     0.00 +     *
 74     0.02     0.01     0.00+      *
 75     0.02     0.01     0.00+      *
 76     0.02     0.01     0.00+     *
 77     0.02     0.00     0.00+     *
       IS *     IS +   IS     *         *         *         *         *
                             0.005     0.026     0.048     0.070     0.091
```

```
DEPRECIATION PATTERN FOR SECTOR NUMBER        7  -  KNITTING, HOSIERY

DATE  DEP      D1
       IS *     IS +   IS     *         *         *         *         *
 48     0.05     0.10     0.00                     *                      +
 49     0.05     0.09     0.00                   *                   +
 50     0.04     0.08     0.00                 *                 +
 51     0.04     0.07     0.00               *               +
 52     0.04     0.07     0.00              *             +
 53     0.03     0.06     0.00             *           +
 54     0.03     0.05     0.00            *         +
 55     0.03     0.05     0.00           *       +
 56     0.03     0.04     0.00           *     +
 57     0.03     0.04     0.00          *    +
 58     0.03     0.03     0.00          *  +
 59     0.03     0.03     0.00          * +
 60     0.03     0.03     0.00         *+
 61     0.02     0.03     0.00         +
 62     0.02     0.02     0.00        +*
 63     0.02     0.02     0.00       +*
 64     0.02     0.02     0.00      + *
 65     0.02     0.02     0.00     +  *
 66     0.02     0.02     0.00    +  *
 67     0.02     0.01     0.00    +  *
 68     0.02     0.01     0.00   +   *
 69     0.02     0.01     0.00  +   *
 70     0.02     0.01     0.00  +   *
 71     0.02     0.01     0.00 +    *
 72     0.02     0.01     0.00 +   *
 73     0.02     0.01     0.00 +   *
 74     0.02     0.01     0.00+    *
 75     0.02     0.01     0.00+   *
 76     0.01     0.01     0.00+   *
 77     0.01     0.00     0.00+   *
       IS *     IS +   IS     *         *         *         *         *
                             0.005     0.026     0.048     0.070     0.091
```

```
DEPRECIATION PATTERN FOR SECTOR NUMBER        8  - APPAREL & HOUSEHOLD TEXTILES

DATE  DEP      D1
       IS *     IS +   IS     *         *         *         *         *
 48     0.07     0.10     0.00                              *             +
 49     0.06     0.09     0.00                           *           +
 50     0.06     0.08     0.00                        *          +
 51     0.05     0.07     0.00                     *         +
 52     0.05     0.07     0.00                   *        +
 53     0.04     0.06     0.00                  *      +
 54     0.04     0.05     0.00                *     +
 55     0.04     0.05     0.00               *   +
 56     0.03     0.04     0.00             *   +
 57     0.03     0.04     0.00            *  +
 58     0.03     0.03     0.00           * +
 59     0.03     0.03     0.00          * +
 60     0.03     0.03     0.00          +
 61     0.03     0.03     0.00         +
 62     0.02     0.02     0.00        +
 63     0.02     0.02     0.00       +*
 64     0.02     0.02     0.00      +*
 65     0.02     0.02     0.00     + *
 66     0.02     0.02     0.00    + *
 67     0.02     0.01     0.00    + *
 68     0.02     0.01     0.00   + *
 69     0.02     0.01     0.00  +  *
 70     0.02     0.01     0.00  + *
 71     0.01     0.01     0.00 +  *
 72     0.01     0.01     0.00 +  *
 73     0.01     0.01     0.00 + *
 74     0.01     0.01     0.00+  *
 75     0.01     0.01     0.00+  *
 76     0.01     0.01     0.00+ *
 77     0.01     0.00     0.00+ *
       IS *     IS +   IS     *         *         *         *         *
                             0.005     0.026     0.048     0.070     0.091
```

```
DEPRECIATION PATTERN FOR SECTOR NUMBER        9  -  PAPER

DATE  DEP      D1
       IS *     IS +   IS     *         *         *         *         *
 48     0.05     0.10     0.00                      *                     +
 49     0.05     0.09     0.00                    *                  +
 50     0.04     0.08     0.00                  *                +
 51     0.04     0.07     0.00                *              +
 52     0.04     0.07     0.00               *            +
 53     0.04     0.06     0.00              *          +
 54     0.03     0.05     0.00             *        +
 55     0.03     0.05     0.00            *      +
 56     0.03     0.04     0.00           *     +
 57     0.03     0.04     0.00           *   +
 58     0.03     0.03     0.00          *  +
 59     0.03     0.03     0.00          * +
 60     0.03     0.03     0.00         *+
 61     0.02     0.03     0.00         +
 62     0.02     0.02     0.00        +
 63     0.02     0.02     0.00       +*
 64     0.02     0.02     0.00      + *
 65     0.02     0.02     0.00     + *
 66     0.02     0.02     0.00    +  *
 67     0.02     0.01     0.00    +  *
 68     0.02     0.01     0.00   +  *
 69     0.02     0.01     0.00  +   *
 70     0.02     0.01     0.00  +   *
 71     0.02     0.01     0.00 +   *
 72     0.02     0.01     0.00 +   *
 73     0.02     0.01     0.00 +   *
 74     0.02     0.01     0.00+   *
 75     0.01     0.01     0.00+   *
 76     0.01     0.01     0.00+   *
 77     0.01     0.00     0.00+  *
       IS *     IS +   IS     *         *         *         *         *
                             0.005     0.026     0.048     0.070     0.091
```

```
DEPRECIATION PATTERN FOR SECTOR NUMBER       10  -  PRINTING

DATE  DEP      D1
       IS *     IS +   IS     *         *         *         *         *
 48     0.07     0.10     0.00                            *               +
 49     0.06     0.09     0.00                         *             +
 50     0.05     0.08     0.00                      *            +
 51     0.05     0.07     0.00                    *          +
 52     0.04     0.07     0.00                  *         +
 53     0.04     0.06     0.00                *        +
 54     0.04     0.05     0.00               *      +
 55     0.04     0.05     0.00              *    +
 56     0.03     0.04     0.00             *   +
 57     0.03     0.04     0.00            *  +
 58     0.03     0.03     0.00           * +
 59     0.03     0.03     0.00          * +
 60     0.03     0.03     0.00          +
 61     0.03     0.03     0.00         +
 62     0.02     0.02     0.00        +
 63     0.02     0.02     0.00       +*
 64     0.02     0.02     0.00      +*
 65     0.02     0.02     0.00     + *
 66     0.02     0.02     0.00    + *
 67     0.02     0.01     0.00    + *
 68     0.02     0.01     0.00   +  *
 69     0.02     0.01     0.00  +  *
 70     0.02     0.01     0.00  +  *
 71     0.02     0.01     0.00 +  *
 72     0.01     0.01     0.00 +  *
 73     0.01     0.01     0.00 +  *
 74     0.01     0.01     0.00+  *
 75     0.01     0.01     0.00+  *
 76     0.01     0.01     0.00+  *
 77     0.01     0.00     0.00+  *
       IS *     IS +   IS     *         *         *         *         *
                             0.005     0.026     0.048     0.070     0.091
```

```
DEPRECIATION PATTERN FOR SECTOR NUMBER       11  -  AGRICULTURE FERTILIZERS

DATE  DEP      D1
       IS *     IS +   IS     *         *         *         *         *
 48     0.06     0.10     0.00                         *                  +
 49     0.05     0.09     0.00                      *                +
 50     0.05     0.08     0.00                    *              +
 51     0.04     0.07     0.00                  *            +
 52     0.04     0.07     0.00                *           +
 53     0.04     0.06     0.00               *         +
 54     0.04     0.05     0.00              *       +
 55     0.03     0.05     0.00             *     +
 56     0.03     0.04     0.00            *    +
 57     0.03     0.04     0.00           *   +
 58     0.03     0.03     0.00           * +
 59     0.03     0.03     0.00          * +
 60     0.03     0.03     0.00         *+
 61     0.03     0.03     0.00         +
 62     0.02     0.02     0.00        +
 63     0.02     0.02     0.00       +*
 64     0.02     0.02     0.00      + *
 65     0.02     0.02     0.00     + *
 66     0.02     0.02     0.00    +  *
 67     0.02     0.01     0.00    + *
 68     0.02     0.01     0.00   +  *
 69     0.02     0.01     0.00  +   *
 70     0.02     0.01     0.00  +  *
 71     0.02     0.01     0.00 +   *
 72     0.02     0.01     0.00 +   *
 73     0.01     0.01     0.00 +  *
 74     0.01     0.01     0.00+   *
 75     0.01     0.01     0.00+   *
 76     0.01     0.01     0.00+  *
 77     0.01     0.00     0.00+  *
       IS *     IS +   IS     *         *         *         *         *
                             0.005     0.026     0.048     0.070     0.091
```

```
DEPRECIATION PATTERN FOR SECTOR NUMBER       12  -  OTHER CHEMICALS

DATE  DEP      D1
       IS *     IS +   IS     *         *         *         *         *
 48     0.08     0.10     0.00                                   *        +
 49     0.07     0.09     0.00                               *       +
 50     0.07     0.08     0.00                            *      +
 51     0.06     0.07     0.00                         *     +
 52     0.05     0.07     0.00                       *    +
 53     0.05     0.06     0.00                    *    +
 54     0.05     0.05     0.00                  *   +
 55     0.04     0.05     0.00                *  +
 56     0.04     0.04     0.00               * +
 57     0.03     0.04     0.00             * +
 58     0.03     0.03     0.00            *+
 59     0.03     0.03     0.00           *+
 60     0.03     0.03     0.00          +
 61     0.03     0.03     0.00         +
 62     0.02     0.02     0.00        +
 63     0.02     0.02     0.00       +
 64     0.02     0.02     0.00      +*
 65     0.02     0.02     0.00     +*
 66     0.02     0.02     0.00    +*
 67     0.02     0.01     0.00    +*
 68     0.02     0.01     0.00   +*
 69     0.01     0.01     0.00  + *
 70     0.01     0.01     0.00  +*
 71     0.01     0.01     0.00 + *
 72     0.01     0.01     0.00 + *
 73     0.01     0.01     0.00 +*
 74     0.01     0.01     0.00+ *
 75     0.01     0.01     0.00+ *
 76     0.01     0.01     0.00+*
 77     0.01     0.00     0.00+*
       IS *     IS +   IS     *         *         *         *         *
                             0.005     0.026     0.048     0.070     0.091
```

```
DEPRECIATION PATTERN FOR SECTOR NUMBER       13  -  PETROLEUM REFINING & FUEL OIL

DATE  DEP      D1
       IS *     IS +   IS      *         *         *         *         *
 48     0.00     0.10     0.00*                                           +
 49     0.00     0.09     0.00*                                      +
 50     0.00     0.08     0.00*                                  +
 51     0.00     0.07     0.00 *                              +
 52     0.00     0.07     0.00  *                         +
 53     0.01     0.06     0.00   *                     +
 54     0.01     0.05     0.00    *                  +
 55     0.01     0.05     0.00     *               +
 56     0.01     0.04     0.00      *           +
 57     0.02     0.04     0.00       *         +
 58     0.02     0.03     0.00        *      +
 59     0.02     0.03     0.00         *   +
 60     0.02     0.03     0.00          * +
 61     0.02     0.03     0.00          *+
 62     0.03     0.02     0.00          +*
 63     0.03     0.02     0.00         + *
 64     0.03     0.02     0.00        +   *
 65     0.03     0.02     0.00       +    *
 66     0.03     0.02     0.00      +     *
 67     0.03     0.01     0.00     +      *
 68     0.03     0.01     0.00     +      *
 69     0.03     0.01     0.00    +       *
 70     0.03     0.01     0.00    +       *
 71     0.03     0.01     0.00   +        *
 72     0.03     0.01     0.00   +       *
 73     0.03     0.01     0.00   +       *
 74     0.03     0.01     0.00  +        *
 75     0.03     0.01     0.00  +        *
 76     0.02     0.01     0.00  +       *
 77     0.02     0.00     0.00  +       *
       IS *     IS +   IS      *         *         *         *         *
                            0.000     0.023     0.045     0.068     0.091
```

```
DEPRECIATION PATTERN FOR SECTOR NUMBER       14  -  RUBBER & PLASTIC PRODUCTS

DATE  DEP      D1
       IS *     IS +   IS     *         *         *         *         *
 48     0.00     0.10     0.00*                                           +
 49     0.00     0.09     0.00*                                      +
 50     0.00     0.08     0.00*                                  +
 51     0.00     0.07     0.00 *                              +
 52     0.00     0.07     0.00  *                         +
 53     0.01     0.06     0.00   *                     +
 54     0.01     0.05     0.00    *                  +
 55     0.01     0.05     0.00     *               +
 56     0.01     0.04     0.00      *           +
 57     0.02     0.04     0.00       *         +
 58     0.02     0.03     0.00        *      +
 59     0.02     0.03     0.00         *   +
 60     0.02     0.03     0.00          * +
 61     0.02     0.03     0.00          *+
 62     0.03     0.02     0.00          +*
 63     0.03     0.02     0.00         + *
 64     0.03     0.02     0.00        +   *
 65     0.03     0.02     0.00       +    *
 66     0.03     0.02     0.00      +     *
 67     0.03     0.01     0.00     +      *
 68     0.03     0.01     0.00     +      *
 69     0.03     0.01     0.00    +       *
 70     0.03     0.01     0.00    +       *
 71     0.03     0.01     0.00   +        *
 72     0.03     0.01     0.00   +       *
 73     0.03     0.01     0.00   +       *
 74     0.03     0.01     0.00  +        *
 75     0.03     0.01     0.00  +        *
 76     0.02     0.01     0.00  +       *
 77     0.02     0.00     0.00  +       *
       IS *     IS +   IS     *         *         *         *         *
                             0.000     0.023     0.045     0.068     0.091
```

```
DEPRECIATION PATTERN FOR SECTOR NUMBER       15  -  FOOTWEAR AND LEATHER

DATE  DEP      D1
       IS *     IS +   IS     *         *         *         *         *
 48     0.03     0.10     0.00           *                                +
 49     0.03     0.09     0.00         *                             +
 50     0.02     0.08     0.00        *                          +
 51     0.02     0.07     0.00        *                      +
 52     0.02     0.07     0.00        *                   +
 53     0.02     0.06     0.00        *                +
 54     0.02     0.05     0.00        *             +
 55     0.02     0.05     0.00        *          +
 56     0.02     0.04     0.00        *        +
 57     0.02     0.04     0.00        *      +
 58     0.02     0.03     0.00        *    +
 59     0.02     0.03     0.00        *   +
 60     0.02     0.03     0.00         *+
 61     0.02     0.03     0.00         +
 62     0.02     0.02     0.00        +*
 63     0.02     0.02     0.00       + *
 64     0.02     0.02     0.00      +  *
 65     0.02     0.02     0.00     +   *
 66     0.02     0.02     0.00    +    *
 67     0.02     0.01     0.00    +    *
 68     0.02     0.01     0.00   +    *
 69     0.02     0.01     0.00  +     *
 70     0.02     0.01     0.00  +     *
 71     0.02     0.01     0.00 +      *
 72     0.02     0.01     0.00 +     *
 73     0.02     0.01     0.00 +     *
 74     0.02     0.01     0.00+      *
 75     0.02     0.01     0.00+     *
 76     0.02     0.01     0.00+     *
 77     0.02     0.00     0.00+     *
       IS *     IS +   IS     *         *         *         *         *
                             0.005     0.026     0.048     0.070     0.091
```

```
DEPRECIATION PATTERN FOR SECTOR NUMBER       16  -  LUMBER

DATE  DEP      D1
       IS *     IS +   IS      *         *         *         *         *
 48     0.01     0.10     0.00    *                                       +
 49     0.02     0.09     0.00       *                               +
 50     0.03     0.08     0.00          *                        +
 51     0.03     0.07     0.00            *                  +
 52     0.03     0.07     0.00             *              +
 53     0.04     0.06     0.00              *          +
 54     0.04     0.05     0.00               *      +
 55     0.04     0.05     0.00               *   +
 56     0.04     0.04     0.00               * +
 57     0.04     0.04     0.00               +
 58     0.04     0.03     0.00             + *
 59     0.04     0.03     0.00            +  *
 60     0.04     0.03     0.00          +   *
 61     0.04     0.03     0.00         +    *
 62     0.03     0.02     0.00        +    *
 63     0.03     0.02     0.00       +    *
 64     0.03     0.02     0.00      +     *
 65     0.03     0.02     0.00     +     *
 66     0.03     0.02     0.00    +     *
 67     0.03     0.01     0.00    +    *
 68     0.02     0.01     0.00   +     *
 69     0.02     0.01     0.00  +     *
 70     0.02     0.01     0.00  +    *
 71     0.02     0.01     0.00 +     *
 72     0.02     0.01     0.00 +    *
 73     0.02     0.01     0.00 +    *
 74     0.02     0.01     0.00+    *
 75     0.02     0.01     0.00+    *
 76     0.01     0.01     0.00+   *
 77     0.01     0.00     0.00+   *
       IS *     IS +   IS      *         *         *         *         *
                             0.005     0.026     0.048     0.070     0.091
```

```
DEPRECIATION PATTERN FOR SECTOR NUMBER       17  -  FURNITURE

DATE  DEP      D1
       IS *     IS +   IS     *         *         *         *         *
 48     0.01     0.10     0.00   *                                        +
 49     0.01     0.09     0.00  *                                    +
 50     0.01     0.08     0.00  *                                +
 51     0.01     0.07     0.00  *                            +
 52     0.01     0.07     0.00   *                        +
 53     0.01     0.06     0.00   *                     +
 54     0.01     0.05     0.00    *                 +
 55     0.02     0.05     0.00     *             +
 56     0.02     0.04     0.00      *          +
 57     0.02     0.04     0.00      *        +
 58     0.02     0.03     0.00       *     +
 59     0.02     0.03     0.00        *   +
 60     0.02     0.03     0.00        * +
 61     0.02     0.03     0.00         +
 62     0.03     0.02     0.00        +*
 63     0.03     0.02     0.00       + *
 64     0.03     0.02     0.00      +   *
 65     0.03     0.02     0.00     +    *
 66     0.03     0.02     0.00    +     *
 67     0.03     0.01     0.00    +     *
 68     0.03     0.01     0.00   +      *
 69     0.03     0.01     0.00  +      *
 70     0.03     0.01     0.00  +      *
 71     0.03     0.01     0.00 +       *
 72     0.02     0.01     0.00 +       *
 73     0.02     0.01     0.00 +       *
 74     0.02     0.01     0.00+       *
 75     0.02     0.01     0.00+       *
 76     0.02     0.01     0.00+       *
 77     0.02     0.00     0.00+      *
       IS *     IS +   IS     *         *         *         *         *
                             0.005     0.026     0.048     0.070     0.091
```

```
DEPRECIATION PATTERN FOR SECTOR NUMBER       18  -  STONE, CLAY & GLASS

DATE  DEP       D1
       IS *     IS +   IS     *         *         *         *         *
 48     0.08     0.10     0.00                                  *         +
 49     0.07     0.09     0.00                              *        +
 50     0.06     0.08     0.00                           *       +
 51     0.06     0.07     0.00                        *      +
 52     0.05     0.07     0.00                      *     +
 53     0.05     0.06     0.00                   *     +
 54     0.04     0.05     0.00                  *   +
 55     0.04     0.05     0.00                *  +
 56     0.04     0.04     0.00              *  +
 57     0.03     0.04     0.00             * +
 58     0.03     0.03     0.00            *+
 59     0.03     0.03     0.00           *+
 60     0.03     0.03     0.00          +
 61     0.03     0.03     0.00         +
 62     0.02     0.02     0.00        +
 63     0.02     0.02     0.00       +
 64     0.02     0.02     0.00      +*
 65     0.02     0.02     0.00     +*
 66     0.02     0.02     0.00    + *
 67     0.02     0.01     0.00    +*
 68     0.02     0.01     0.00   + *
 69     0.01     0.01     0.00  + *
 70     0.01     0.01     0.00  + *
 71     0.01     0.01     0.00 + *
 72     0.01     0.01     0.00 + *
 73     0.01     0.01     0.00 + *
 74     0.01     0.01     0.00+ *
 75     0.01     0.01     0.00+ *
 76     0.01     0.01     0.00+ *
 77     0.01     0.00     0.00+*
       IS *     IS +   IS     *         *         *         *         *
                             0.005     0.026     0.048     0.070     0.091
```

```
DEPRECIATION PATTERN FOR SECTOR NUMBER       20  -  NON-FERROUS METALS

DATE  DEP      D1
       IS *     IS +   IS     *         *         *         *         *
 48     0.01     0.10     0.00    *                                       +
 49     0.01     0.09     0.00   *                                   +
 50     0.01     0.08     0.00   *                               +
 51     0.01     0.07     0.00   *                           +
 52     0.01     0.07     0.00    *                       +
 53     0.01     0.06     0.00    *                    +
 54     0.02     0.05     0.00     *                +
 55     0.02     0.05     0.00     *             +
 56     0.02     0.04     0.00      *          +
 57     0.02     0.04     0.00       *       +
 58     0.02     0.03     0.00       *     +
 59     0.02     0.03     0.00        *   +
 60     0.02     0.03     0.00        * +
 61     0.02     0.03     0.00         +
 62     0.03     0.02     0.00        +*
 63     0.03     0.02     0.00       + *
 64     0.03     0.02     0.00      +  *
 65     0.03     0.02     0.00     +    *
 66     0.03     0.02     0.00    +     *
 67     0.03     0.01     0.00    +     *
 68     0.03     0.01     0.00   +     *
 69     0.03     0.01     0.00  +      *
 70     0.03     0.01     0.00  +      *
 71     0.02     0.01     0.00 +       *
 72     0.02     0.01     0.00 +       *
 73     0.02     0.01     0.00 +      *
 74     0.02     0.01     0.00+       *
 75     0.02     0.01     0.00+       *
 76     0.02     0.01     0.00+      *
 77     0.02     0.00     0.00+      *
       IS *     IS +   IS     *         *         *         *         *
                             0.005     0.026     0.048     0.070     0.091
```

```
DEPRECIATION PATTERN FOR SECTOR NUMBER       21  -  METAL PRODUCTS

DATE  DEP      D1
       IS *     IS +   IS     *         *         *         *         *
 48     0.01     0.10     0.00  *                                         +
 49     0.02     0.09     0.00      *                                +
 50     0.02     0.08     0.00         *                         +
 51     0.03     0.07     0.00           *                   +
 52     0.03     0.07     0.00             *              +
 53     0.04     0.06     0.00              *          +
 54     0.04     0.05     0.00               *      +
 55     0.04     0.05     0.00               *   +
 56     0.04     0.04     0.00               * +
 57     0.04     0.04     0.00               +
 58     0.04     0.03     0.00             + *
 59     0.04     0.03     0.00            +  *
 60     0.04     0.03     0.00          +   *
 61     0.04     0.03     0.00         +    *
 62     0.03     0.02     0.00        +    *
 63     0.03     0.02     0.00       +     *
 64     0.03     0.02     0.00      +     *
 65     0.03     0.02     0.00     +     *
 66     0.03     0.02     0.00    +     *
 67     0.03     0.01     0.00    +     *
 68     0.03     0.01     0.00   +     *
 69     0.02     0.01     0.00  +     *
 70     0.02     0.01     0.00  +     *
 71     0.02     0.01     0.00 +     *
 72     0.02     0.01     0.00 +    *
 73     0.02     0.01     0.00 +    *
 74     0.02     0.01     0.00+    *
 75     0.02     0.01     0.00+    *
 76     0.02     0.01     0.00+   *
 77     0.01     0.00     0.00+   *
       IS *     IS +   IS     *         *         *         *         *
                             0.005     0.026     0.048     0.070     0.091
```

```
DEPRECIATION PATTERN FOR SECTOR NUMBER       22  -  ENGINES & TURBINS

DATE  DEP      D1
       IS *     IS +   IS     *         *         *         *         *
 48     0.08     0.10     0.00                                   *        +
 49     0.07     0.09     0.00                               *       +
 50     0.07     0.08     0.00                            *      +
 51     0.06     0.07     0.00                         *     +
 52     0.05     0.07     0.00                       *    +
 53     0.05     0.06     0.00                    *    +
 54     0.05     0.05     0.00                  *   +
 55     0.04     0.05     0.00                *  +
 56     0.04     0.04     0.00               * +
 57     0.03     0.04     0.00             * +
 58     0.03     0.03     0.00            *+
 59     0.03     0.03     0.00           *+
 60     0.03     0.03     0.00          +
 61     0.03     0.03     0.00         +
 62     0.02     0.02     0.00        +
 63     0.02     0.02     0.00       +
 64     0.02     0.02     0.00      +*
 65     0.02     0.02     0.00     +*
 66     0.02     0.02     0.00    +*
 67     0.02     0.01     0.00    +*
 68     0.02     0.01     0.00   +*
 69     0.01     0.01     0.00  + *
 70     0.01     0.01     0.00  +*
 71     0.01     0.01     0.00 + *
 72     0.01     0.01     0.00 + *
 73     0.01     0.01     0.00 +*
 74     0.01     0.01     0.00+ *
 75     0.01     0.01     0.00+ *
 76     0.01     0.01     0.00+*
 77     0.01     0.00     0.00+*
       IS *     IS +   IS     *         *         *         *         *
                             0.005     0.026     0.048     0.070     0.091
```

```
DEPRECIATION PATTERN FOR SECTOR NUMBER       23  -  AGRICULTURE MACHINERY

DATE  DEP      D1
       IS *     IS +   IS      *         *         *         *         *
 48     0.00     0.10     0.00*                                           +
 49     0.01     0.09     0.00    *                                  +
 50     0.02     0.08     0.00       *                           +
 51     0.02     0.07     0.00          *                     +
 52     0.03     0.07     0.00            *               +
 53     0.03     0.06     0.00              *          +
 54     0.04     0.05     0.00               *       +
 55     0.04     0.05     0.00                *    +
 56     0.04     0.04     0.00                * +
 57     0.04     0.04     0.00                 +
 58     0.04     0.03     0.00               + *
 59     0.04     0.03     0.00             +  *
 60     0.04     0.03     0.00            +   *
 61     0.04     0.03     0.00           +    *
 62     0.04     0.02     0.00          +    *
 63     0.03     0.02     0.00         +     *
 64     0.03     0.02     0.00        +     *
 65     0.03     0.02     0.00       +     *
 66     0.03     0.02     0.00      +      *
 67     0.03     0.01     0.00     +      *
 68     0.03     0.01     0.00     +     *
 69     0.03     0.01     0.00    +      *
 70     0.02     0.01     0.00    +     *
 71     0.02     0.01     0.00   +     *
 72     0.02     0.01     0.00   +     *
 73     0.02     0.01     0.00   +    *
 74     0.02     0.01     0.00  +     *
 75     0.02     0.01     0.00  +    *
 76     0.02     0.01     0.00  +    *
 77     0.02     0.00     0.00  +   *
       IS *     IS +   IS      *         *         *         *         *
                             0.000     0.023     0.045     0.068     0.091
```

```
DEPRECIATION PATTERN FOR SECTOR NUMBER       31  -  COMMUNICATIONS MACHINERY

DATE  DEP      D1
       IS *     IS +   IS      *         *         *         *         *
 48     0.05     0.10     0.00                     *                      +
 49     0.05     0.09     0.00                     *                 +
 50     0.05     0.08     0.00                     *             +
 51     0.05     0.07     0.00                    *          +
 52     0.05     0.07     0.00                   *        +
 53     0.05     0.06     0.00                   *     +
 54     0.04     0.05     0.00                  *   +
 55     0.04     0.05     0.00                 * +
 56     0.04     0.04     0.00                *+
 57     0.04     0.04     0.00               +
 58     0.04     0.03     0.00             +*
 59     0.03     0.03     0.00            +*
 60     0.03     0.03     0.00          + *
 61     0.03     0.03     0.00         +  *
 62     0.03     0.02     0.00        +  *
 63     0.03     0.02     0.00       +  *
 64     0.03     0.02     0.00      +  *
 65     0.02     0.02     0.00     +  *
 66     0.02     0.02     0.00    +   *
 67     0.02     0.01     0.00    +  *
 68     0.02     0.01     0.00   +  *
 69     0.02     0.01     0.00  +   *
 70     0.02     0.01     0.00  +  *
 71     0.02     0.01     0.00 +   *
 72     0.01     0.01     0.00 +  *
 73     0.01     0.01     0.00 +  *
 74     0.01     0.01     0.00+  *
 75     0.01     0.01     0.00+  *
 76     0.01     0.01     0.00+ *
 77     0.01     0.00     0.00+ *
       IS *     IS +   IS      *         *         *         *         *
                            0.005     0.026     0.048     0.070     0.091
```

```
DEPRECIATION PATTERN FOR SECTOR NUMBER       33  -  HOUSEHOLD APPLIANCES

DATE  DEP      D1
       IS *     IS +   IS     *         *         *         *         *
 48     0.07     0.10     0.00                                *           +
 49     0.07     0.09     0.00                            *          +
 50     0.06     0.08     0.00                         *         +
 51     0.06     0.07     0.00                       *       +
 52     0.05     0.07     0.00                     *      +
 53     0.05     0.06     0.00                   *     +
 54     0.04     0.05     0.00                 *    +
 55     0.04     0.05     0.00               *   +
 56     0.04     0.04     0.00              *  +
 57     0.03     0.04     0.00             * +
 58     0.03     0.03     0.00            *+
 59     0.03     0.03     0.00           *+
 60     0.03     0.03     0.00          +
 61     0.03     0.03     0.00         +
 62     0.02     0.02     0.00        +
 63     0.02     0.02     0.00       +*
 64     0.02     0.02     0.00      +*
 65     0.02     0.02     0.00     +*
 66     0.02     0.02     0.00    + *
 67     0.02     0.01     0.00    +*
 68     0.02     0.01     0.00   + *
 69     0.02     0.01     0.00  + *
 70     0.01     0.01     0.00  + *
 71     0.01     0.01     0.00 +  *
 72     0.01     0.01     0.00 + *
 73     0.01     0.01     0.00 + *
 74     0.01     0.01     0.00+  *
 75     0.01     0.01     0.00+ *
 76     0.01     0.01     0.00+ *
 77     0.01     0.00     0.00+ *
       IS *     IS +   IS     *         *         *         *         *
                             0.005     0.026     0.048     0.070     0.091
```

```
DEPRECIATION PATTERN FOR SECTOR NUMBER       34  - ELECTRICAL LIGHT.& WIRING EQUIPMENT

DATE  DEP      D1
       IS *     IS +   IS     *         *         *         *         *
 48     0.06     0.10     0.00                          *                 +
 49     0.06     0.09     0.00                       *               +
 50     0.05     0.08     0.00                     *             +
 51     0.05     0.07     0.00                   *           +
 52     0.04     0.07     0.00                 *          +
 53     0.04     0.06     0.00                *        +
 54     0.04     0.05     0.00              *       +
 55     0.03     0.05     0.00             *     +
 56     0.03     0.04     0.00            *    +
 57     0.03     0.04     0.00           *   +
 58     0.03     0.03     0.00           * +
 59     0.03     0.03     0.00          * +
 60     0.03     0.03     0.00         *+
 61     0.03     0.03     0.00         +
 62     0.02     0.02     0.00        +
 63     0.02     0.02     0.00       +*
 64     0.02     0.02     0.00      +*
 65     0.02     0.02     0.00     + *
 66     0.02     0.02     0.00    +  *
 67     0.02     0.01     0.00    + *
 68     0.02     0.01     0.00   +  *
 69     0.02     0.01     0.00  +  *
 70     0.02     0.01     0.00  +  *
 71     0.02     0.01     0.00 +   *
 72     0.02     0.01     0.00 +  *
 73     0.01     0.01     0.00 +  *
 74     0.01     0.01     0.00+   *
 75     0.01     0.01     0.00+  *
 76     0.01     0.01     0.00+  *
 77     0.01     0.00     0.00+  *
       IS *     IS +   IS     *         *         *         *         *
                            0.005     0.026     0.048     0.070     0.091
```

```
DEPRECIATION PATTERN FOR SECTOR NUMBER       35  - RADIO, TV RECEIVING, PHONOGRAPH

DATE  DEP      D1
       IS *     IS +   IS     *         *         *         *         *
 48     0.00     0.10     0.00*                                           +
 49     0.00     0.09     0.00*                                      +
 50     0.00     0.08     0.00*                                  +
 51     0.00     0.07     0.00 *                              +
 52     0.00     0.07     0.00  *                         +
 53     0.01     0.06     0.00   *                     +
 54     0.01     0.05     0.00    *                  +
 55     0.01     0.05     0.00     *               +
 56     0.01     0.04     0.00      *           +
 57     0.02     0.04     0.00       *         +
 58     0.02     0.03     0.00        *      +
 59     0.02     0.03     0.00         *   +
 60     0.02     0.03     0.00          * +
 61     0.02     0.03     0.00          *+
 62     0.03     0.02     0.00          +*
 63     0.03     0.02     0.00         + *
 64     0.03     0.02     0.00        +   *
 65     0.03     0.02     0.00       +    *
 66     0.03     0.02     0.00      +     *
 67     0.03     0.01     0.00     +      *
 68     0.03     0.01     0.00     +      *
 69     0.03     0.01     0.00    +       *
 70     0.03     0.01     0.00    +       *
 71     0.03     0.01     0.00   +        *
 72     0.03     0.01     0.00   +       *
 73     0.03     0.01     0.00   +       *
 74     0.03     0.01     0.00  +        *
 75     0.03     0.01     0.00  +        *
 76     0.02     0.01     0.00  +       *
 77     0.02     0.00     0.00  +       *
       IS *     IS +   IS     *         *         *         *         *
                             0.000     0.023     0.045     0.068     0.091
```

```
DEPRECIATION PATTERN FOR SECTOR NUMBER      38   -  SHIPS & BOATS

DATE  DEP      D1
       IS *     IS +   IS     *         *         *         *         *
 48     0.05     0.10     0.00                   *                        +
 49     0.05     0.09     0.00                   *                   +
 50     0.05     0.08     0.00                   *               +
 51     0.05     0.07     0.00                   *           +
 52     0.05     0.07     0.00                   *        +
 53     0.05     0.06     0.00                  *      +
 54     0.04     0.05     0.00                  *   +
 55     0.04     0.05     0.00                 * +
 56     0.04     0.04     0.00                *+
 57     0.04     0.04     0.00               +
 58     0.04     0.03     0.00             +*
 59     0.04     0.03     0.00            + *
 60     0.03     0.03     0.00          +  *
 61     0.03     0.03     0.00         +  *
 62     0.03     0.02     0.00        +  *
 63     0.03     0.02     0.00       +  *
 64     0.03     0.02     0.00      +  *
 65     0.02     0.02     0.00     +   *
 66     0.02     0.02     0.00    +   *
 67     0.02     0.01     0.00    +  *
 68     0.02     0.01     0.00   +   *
 69     0.02     0.01     0.00  +   *
 70     0.02     0.01     0.00  +  *
 71     0.02     0.01     0.00 +   *
 72     0.01     0.01     0.00 +  *
 73     0.01     0.01     0.00 +  *
 74     0.01     0.01     0.00+  *
 75     0.01     0.01     0.00+  *
 76     0.01     0.01     0.00+ *
 77     0.01     0.00     0.00+ *
       IS *     IS +   IS     *         *         *         *         *
                            0.005     0.026     0.048     0.070     0.091
```

```
DEPRECIATION PATTERN FOR SECTOR NUMBER       40  -  INSTRUMENTS

DATE  DEP      D1
       IS *     IS +   IS     *         *         *         *         *
 48     0.00     0.10     0.00*                                           +
 49     0.00     0.09     0.00*                                      +
 50     0.00     0.08     0.00*                                  +
 51     0.00     0.07     0.00 *                              +
 52     0.01     0.07     0.00  *                         +
 53     0.01     0.06     0.00   *                     +
 54     0.01     0.05     0.00     *                 +
 55     0.01     0.05     0.00      *              +
 56     0.02     0.04     0.00       *          +
 57     0.02     0.04     0.00        *        +
 58     0.02     0.03     0.00         *     +
 59     0.02     0.03     0.00         *   +
 60     0.02     0.03     0.00          * +
 61     0.03     0.03     0.00           +
 62     0.03     0.02     0.00          +*
 63     0.03     0.02     0.00         + *
 64     0.03     0.02     0.00        +   *
 65     0.03     0.02     0.00       +    *
 66     0.03     0.02     0.00      +     *
 67     0.03     0.01     0.00     +      *
 68     0.03     0.01     0.00     +      *
 69     0.03     0.01     0.00    +       *
 70     0.03     0.01     0.00    +       *
 71     0.03     0.01     0.00   +        *
 72     0.03     0.01     0.00   +       *
 73     0.03     0.01     0.00   +       *
 74     0.03     0.01     0.00  +        *
 75     0.02     0.01     0.00  +       *
 76     0.02     0.01     0.00  +       *
 77     0.02     0.00     0.00  +       *
       IS *     IS +   IS     *         *         *         *         *
                             0.000     0.023     0.045     0.068     0.091
```

```
DEPRECIATION PATTERN FOR SECTOR NUMBER       42  -  RAILROADS

DATE  DEP      D1
       IS *     IS +   IS     *         *         *         *         *
 48    0.07     0.10     0.00                                *           +
 49    0.07     0.09     0.00                            *          +
 50    0.06     0.08     0.00                         *         +
 51    0.06     0.07     0.00                       *       +
 52    0.05     0.07     0.00                     *      +
 53    0.05     0.06     0.00                   *     +
 54    0.04     0.05     0.00                 *    +
 55    0.04     0.05     0.00               *   +
 56    0.04     0.04     0.00              *  +
 57    0.03     0.04     0.00             * +
 58    0.03     0.03     0.00            *+
 59    0.03     0.03     0.00           *+
 60    0.03     0.03     0.00          +
 61    0.03     0.03     0.00         +
 62    0.02     0.02     0.00        +
 63    0.02     0.02     0.00       +*
 64    0.02     0.02     0.00      +*
 65    0.02     0.02     0.00     +*
 66    0.02     0.02     0.00    + *
 67    0.02     0.01     0.00    +*
 68    0.02     0.01     0.00   + *
 69    0.02     0.01     0.00  + *
 70    0.01     0.01     0.00  + *
 71    0.01     0.01     0.00 +  *
 72    0.01     0.01     0.00 + *
 73    0.01     0.01     0.00 + *
 74    0.01     0.01     0.00+  *
 75    0.01     0.01     0.00+ *
 76    0.01     0.01     0.00+ *
 77    0.01     0.00     0.00+ *
       IS *     IS +   IS     *         *         *         *         *
                            0.005     0.026     0.048     0.070     0.091
```

```
DEPRECIATION PATTERN FOR SECTOR NUMBER       43  -  AIR TRANSPORT

DATE  DEP      D1
       IS *     IS +   IS     *         *         *         *         *
 48     0.07     0.10     0.00                             *              +
 49     0.06     0.09     0.00                          *            +
 50     0.06     0.08     0.00                       *           +
 51     0.05     0.07     0.00                     *         +
 52     0.05     0.07     0.00                   *        +
 53     0.04     0.06     0.00                 *       +
 54     0.04     0.05     0.00                *     +
 55     0.04     0.05     0.00              *    +
 56     0.03     0.04     0.00             *   +
 57     0.03     0.04     0.00            *  +
 58     0.03     0.03     0.00           * +
 59     0.03     0.03     0.00          * +
 60     0.03     0.03     0.00          +
 61     0.03     0.03     0.00         +
 62     0.02     0.02     0.00        +
 63     0.02     0.02     0.00       +*
 64     0.02     0.02     0.00      +*
 65     0.02     0.02     0.00     + *
 66     0.02     0.02     0.00    + *
 67     0.02     0.01     0.00    + *
 68     0.02     0.01     0.00   + *
 69     0.02     0.01     0.00  +  *
 70     0.02     0.01     0.00  + *
 71     0.01     0.01     0.00 +  *
 72     0.01     0.01     0.00 +  *
 73     0.01     0.01     0.00 + *
 74     0.01     0.01     0.00+  *
 75     0.01     0.01     0.00+  *
 76     0.01     0.01     0.00+ *
 77     0.01     0.00     0.00+ *
       IS *     IS +   IS     *         *         *         *         *
                             0.005     0.026     0.048     0.070     0.091
```

```
DEPRECIATION PATTERN FOR SECTOR NUMBER       45  -  COMMUNICATIONS SERVICES

DATE  DEP      D1
       IS *     IS +   IS      *         *         *         *         *
 48     0.04     0.10     0.00                *                           +
 49     0.04     0.09     0.00              *                        +
 50     0.03     0.08     0.00             *                     +
 51     0.03     0.07     0.00            *                  +
 52     0.03     0.07     0.00           *                +
 53     0.03     0.06     0.00          *              +
 54     0.03     0.05     0.00          *           +
 55     0.03     0.05     0.00          *        +
 56     0.03     0.04     0.00         *       +
 57     0.03     0.04     0.00         *     +
 58     0.03     0.03     0.00         *   +
 59     0.03     0.03     0.00         *  +
 60     0.03     0.03     0.00         *+
 61     0.02     0.03     0.00         +
 62     0.02     0.02     0.00        +*
 63     0.02     0.02     0.00       + *
 64     0.02     0.02     0.00      + *
 65     0.02     0.02     0.00     +  *
 66     0.02     0.02     0.00    +   *
 67     0.02     0.01     0.00    +   *
 68     0.02     0.01     0.00   +   *
 69     0.02     0.01     0.00  +    *
 70     0.02     0.01     0.00  +    *
 71     0.02     0.01     0.00 +     *
 72     0.02     0.01     0.00 +    *
 73     0.02     0.01     0.00 +    *
 74     0.02     0.01     0.00+     *
 75     0.02     0.01     0.00+    *
 76     0.02     0.01     0.00+    *
 77     0.02     0.00     0.00+    *
       IS *     IS +   IS      *         *         *         *         *
                             0.005     0.026     0.048     0.070     0.091
```

```
DEPRECIATION PATTERN FOR SECTOR NUMBER       46  -  ELECTRIC UTILITIES

DATE  DEP      D1
       IS *     IS +    IS     *         *         *         *         *
 48     0.00     0.10     0.00*                                           +
 49     0.00     0.09     0.00*                                      +
 50     0.00     0.08     0.00*                                  +
 51     0.00     0.07     0.00 *                              +
 52     0.00     0.07     0.00  *                         +
 53     0.01     0.06     0.00   *                     +
 54     0.01     0.05     0.00    *                  +
 55     0.01     0.05     0.00     *               +
 56     0.01     0.04     0.00      *           +
 57     0.02     0.04     0.00       *         +
 58     0.02     0.03     0.00        *      +
 59     0.02     0.03     0.00         *   +
 60     0.02     0.03     0.00          * +
 61     0.02     0.03     0.00          *+
 62     0.03     0.02     0.00          +*
 63     0.03     0.02     0.00         + *
 64     0.03     0.02     0.00        +   *
 65     0.03     0.02     0.00       +    *
 66     0.03     0.02     0.00      +     *
 67     0.03     0.01     0.00     +      *
 68     0.03     0.01     0.00     +      *
 69     0.03     0.01     0.00    +       *
 70     0.03     0.01     0.00    +       *
 71     0.03     0.01     0.00   +        *
 72     0.03     0.01     0.00   +       *
 73     0.03     0.01     0.00   +       *
 74     0.03     0.01     0.00  +        *
 75     0.03     0.01     0.00  +        *
 76     0.02     0.01     0.00  +       *
 77     0.02     0.00     0.00  +       *
       IS *     IS +    IS     *         *         *         *         *
                             0.000     0.023     0.045     0.068     0.091
```

```
DEPRECIATION PATTERN FOR SECTOR NUMBER       47  -  GAS, WATER & SANITATION

DATE  DEP      D1
       IS *     IS +   IS     *         *         *         *         *
 48     0.07     0.10     0.00                             *              +
 49     0.06     0.09     0.00                          *            +
 50     0.06     0.08     0.00                       *           +
 51     0.05     0.07     0.00                     *         +
 52     0.05     0.07     0.00                   *        +
 53     0.04     0.06     0.00                 *       +
 54     0.04     0.05     0.00                *     +
 55     0.04     0.05     0.00              *    +
 56     0.03     0.04     0.00             *   +
 57     0.03     0.04     0.00            *  +
 58     0.03     0.03     0.00           * +
 59     0.03     0.03     0.00          * +
 60     0.03     0.03     0.00          +
 61     0.03     0.03     0.00         +
 62     0.02     0.02     0.00        +
 63     0.02     0.02     0.00       +*
 64     0.02     0.02     0.00      +*
 65     0.02     0.02     0.00     + *
 66     0.02     0.02     0.00    + *
 67     0.02     0.01     0.00    + *
 68     0.02     0.01     0.00   + *
 69     0.02     0.01     0.00  +  *
 70     0.02     0.01     0.00  +  *
 71     0.01     0.01     0.00 +  *
 72     0.01     0.01     0.00 +  *
 73     0.01     0.01     0.00 + *
 74     0.01     0.01     0.00+  *
 75     0.01     0.01     0.00+  *
 76     0.01     0.01     0.00+  *
 77     0.01     0.00     0.00+ *
       IS *     IS +   IS     *         *         *         *         *
                            0.005     0.026     0.048     0.070     0.091
```

```
DEPRECIATION PATTERN FOR SECTOR NUMBER       52  -  HOTELS & REPAIRS MINUS AUTO

DATE  DEP      D1
       IS *     IS +   IS     *         *         *         *         *
 48     0.07     0.10     0.00                              *             +
 49     0.06     0.09     0.00                           *           +
 50     0.06     0.08     0.00                        *          +
 51     0.05     0.07     0.00                     *         +
 52     0.05     0.07     0.00                   *        +
 53     0.04     0.06     0.00                  *      +
 54     0.04     0.05     0.00                *     +
 55     0.04     0.05     0.00               *   +
 56     0.03     0.04     0.00             *   +
 57     0.03     0.04     0.00            *  +
 58     0.03     0.03     0.00           * +
 59     0.03     0.03     0.00          * +
 60     0.03     0.03     0.00          +
 61     0.03     0.03     0.00         +
 62     0.02     0.02     0.00        +
 63     0.02     0.02     0.00       +*
 64     0.02     0.02     0.00      +*
 65     0.02     0.02     0.00     + *
 66     0.02     0.02     0.00    + *
 67     0.02     0.01     0.00    + *
 68     0.02     0.01     0.00   + *
 69     0.02     0.01     0.00  +  *
 70     0.02     0.01     0.00  + *
 71     0.01     0.01     0.00 +  *
 72     0.01     0.01     0.00 +  *
 73     0.01     0.01     0.00 + *
 74     0.01     0.01     0.00+  *
 75     0.01     0.01     0.00+  *
 76     0.01     0.01     0.00+ *
 77     0.01     0.00     0.00+ *
       IS *     IS +   IS     *         *         *         *         *
                             0.005     0.026     0.048     0.070     0.091
```

```
DEPRECIATION PATTERN FOR SECTOR NUMBER       54  -  MOVIES & AMUSEMENTS

DATE  DEP      D1
       IS *     IS +   IS      *         *         *         *         *
 48     0.01     0.10     0.00 *                                          +
 49     0.01     0.09     0.00 *                                     +
 50     0.01     0.08     0.00 *                                 +
 51     0.01     0.07     0.00 *                             +
 52     0.01     0.07     0.00  *                         +
 53     0.01     0.06     0.00   *                     +
 54     0.01     0.05     0.00    *                 +
 55     0.02     0.05     0.00    *              +
 56     0.02     0.04     0.00     *           +
 57     0.02     0.04     0.00      *        +
 58     0.02     0.03     0.00       *     +
 59     0.02     0.03     0.00        *   +
 60     0.02     0.03     0.00        * +
 61     0.02     0.03     0.00         +
 62     0.03     0.02     0.00        +*
 63     0.03     0.02     0.00       + *
 64     0.03     0.02     0.00      +   *
 65     0.03     0.02     0.00     +    *
 66     0.03     0.02     0.00    +     *
 67     0.03     0.01     0.00    +     *
 68     0.03     0.01     0.00   +      *
 69     0.03     0.01     0.00  +       *
 70     0.03     0.01     0.00  +       *
 71     0.03     0.01     0.00 +       *
 72     0.03     0.01     0.00 +       *
 73     0.02     0.01     0.00 +       *
 74     0.02     0.01     0.00+        *
 75     0.02     0.01     0.00+       *
 76     0.02     0.01     0.00+       *
 77     0.02     0.00     0.00+      *
       IS *     IS +   IS      *         *         *         *         *
                             0.005     0.026     0.048     0.070     0.091
```

```
DEPRECIATION PATTERN FOR SECTOR NUMBER       55  -  MEDICAL & EDUCATIONAL SERVICES

DATE  DEP      D1
       IS *     IS +   IS     *         *         *         *         *
 48     0.06     0.10     0.00                           *                +
 49     0.06     0.09     0.00                        *              +
 50     0.05     0.08     0.00                     *             +
 51     0.05     0.07     0.00                   *           +
 52     0.04     0.07     0.00                 *          +
 53     0.04     0.06     0.00                *        +
 54     0.04     0.05     0.00               *      +
 55     0.03     0.05     0.00             *     +
 56     0.03     0.04     0.00            *    +
 57     0.03     0.04     0.00            *  +
 58     0.03     0.03     0.00           * +
 59     0.03     0.03     0.00          * +
 60     0.03     0.03     0.00         *+
 61     0.03     0.03     0.00         +
 62     0.02     0.02     0.00        +
 63     0.02     0.02     0.00       +*
 64     0.02     0.02     0.00      +*
 65     0.02     0.02     0.00     + *
 66     0.02     0.02     0.00    +  *
 67     0.02     0.01     0.00    + *
 68     0.02     0.01     0.00   +  *
 69     0.02     0.01     0.00  +  *
 70     0.02     0.01     0.00  +  *
 71     0.02     0.01     0.00 +   *
 72     0.01     0.01     0.00 +  *
 73     0.01     0.01     0.00 +  *
 74     0.01     0.01     0.00+   *
 75     0.01     0.01     0.00+  *
 76     0.01     0.01     0.00+  *
 77     0.01     0.00     0.00+  *
       IS *     IS +   IS     *         *         *         *         *
                             0.005     0.026     0.048     0.070     0.091
```

# Chapter 6

# Forecast 1977-1983

## 1. Introduction

The estimated equations presented in the previous chapter were used to forecast investment and employment from 1977, the last year of the estimation period, through 1983. Actual data on employment by industry exists through 1981. Consequently, we have an opportunity to compare forecasted employment to actual employment for each industry. Equipment investment data at the industry level used in this study do not exist beyond 1977. Industry investment through 1980 has been constructed by INFORUM based upon published aggregate data. We have, therefore, a rough benchmark with which to judge the investment forecasts.

In section 2, there is a brief description of how "actual" investment data were constructed. In addition, we outline the manner in which the independent variables in the equations are generated in LIFT. In section 3, we present the forecasts and compare them with actual employment and constructed investment data through 1981. The implied productivity growth appears to be excessive for many industries while the investment equations predict investment which is higher than the constructed numbers. We offer some explanations of these forecasts. Section 4 contains a summary of our results and comments about the need for future work.

## 2. Preliminary Data Work

The forecasts presented in the next section are compared with investment numbers which were derived from the BEA Plant and Equipment Survey which is published periodically in the Survey of Current Business (SCB). The BEA survey gives actual plant and equipment investment by various aggregate industries in current dollars. In addition, the survey distinguishes between plant and equipment purchases for a number of these aggregates. A series of regression equations were estimated which related the 53 investment series used in this study to the BEA survey numbers. The independent variables were either an equipment number for one of the aggregate industries or a plant and equipment number from one of the appropriate disaggregated industries.[1] Then, by using the equation with the highest $R^2$, investment was forecasted for the 53 industries through 1981. Consequently, although the investment numbers for 1978-81 are only estimates, they are derived from aggregates which do exist through 1981.

In order for investment and employment to be forecast, values for the independent variables must be available. Specifically, average hourly compensation, industry energy prices and the user cost of capital are the prices which enter the employment and investment equations. Average hourly compensation data exist through 1979 and are forecasted thereafter by a combination of relative wage equations and two aggregate wage equations, one for manufacturing and one for nonmanufacturing.[2] Energy prices are generated by weighting the relevant forecasted output deflators with the appropriate I-O coefficients, as described in Chapter 4. The I-O coefficients may vary from year to year in the forecast; these variations may alter the energy price variable. A description of the way in which the forecasting of I-0 coefficients is made may be found in (1)

Recalling the discussion of Chapter 4, the user cost consists of six pieces: the equipment deflator, real rate of interest, rate of physical depreciation, corporate tax rate, and the investment tax credit. The equipment deflator is computed as a weighted average of output deflators, and is described in (1). The construction of the present value of depreciation depends upon the average tax life for equipment and the nominal interest rate. The present value formula is the same as the one used in the estimation, the sum of years digits method, and is presented in (1). The average tax life of equipment was assumed to be the 1977 value up to 1981. Thereafter, the tax life was assumed to be 5 years, consistent with the recent change in the tax laws. The nominal interest rate is generated by a regression equation estimated by INFORUM. The real rate of interest is exogeneous to the LIFT model, so is set to be the constant value which was used in the estimation, .0257. The physical rate of depreciation for the forecast was assumed to be that value which prevailed in 1977. Its computation is described in Chapter 4. The corporate tax rate is 48 percent through 1978, 46 percent in 1979 and 1980, and 44 percent thereafter. The investment tax credit is set at 10 percent throughout the forecast. Finally, output for each industry is simply the sum of final demand and demand as an intermediate good in other products. Final demand consists of consumption, equipment sales, sales to construction, sales to defense expenditures, and exports.[3] Consequetly, investment by industry is not only determined by output, but also helps determine output.

## 3. Forecast Results

To assess the forecasting performance of the investment and employment equations within the context of the LIFT model, Tables 1 and 2 will prove useful. These two tables display, respectively, pairs of investment and employment forecasts through 1981. The columns labeled BASE give the forecasts of investment and employment resulting from the equations estimated for this study. The columns labeled ALT1 provide results from a recent LIFT forecast in which constructed investment and actual employment were used as forecasts through 1981. The two tables provide forecasts for each of the 53 industries, the total for the entire economy, and subtotals for various aggregate sectors of the economy. Companion Tables B1 and B2 in Appendix B provide growth rates for the investment and employment forecasts, respectively. In addition, the implied levels and growth rates of industry productivity are displayed in Tables B3 and B4.

Finally, the tables in Appendix C provide results of the BASE forecast through 1983 along with tables for the independent variables which enter the investment and employment equations: wage index, energy price, price of capital, and product shipments.[4]

Table 1 provides evidence on the forecasting performance of the investment equations. At the aggregate level -- the ALL INDUSTRIES row -- we see that the investment resulting from our industry equations over predicts equipment purchase in every year through 1981. For example, in 1978 the equations predict 164.87 billion dollars in investment, while there was actually only 155.71 billion dollars of purchases in that year. The absolute percentage error (APE) for 1978, at the aggregate level, is approximately 5.8 percent. The APE at the aggregate level for

## TABLE 1

PRODUCERS' DURABLE EQUIPMENT INVESTMENT (BILLIONS OF 1977$)

| | (BASE) 1977 | (BASE) 1978 | (ALT1) 1978 | (BASE) 1979 | (ALT1) 1979 | (BASE) 1980 | (ALT1) 1980 | (BASE) 1981 | (ALT1) 1981 |
|---|---|---|---|---|---|---|---|---|---|
| ALL INDUSTRIES | 150.18 | 164.87 | 155.71 | 182.90 | 164.29 | 188.10 | 157.54 | 176.35 | 162.27 |
| AGRIC, MINING, CONSTRUCTION | 29.31 | 34.98 | 33.33 | 38.42 | 33.42 | 40.85 | 31.53 | 40.12 | 32.63 |
| 1 AGRICULTURE(1) | 11.17 | 14.41 | 13.62 | 14.55 | 13.86 | 14.10 | 12.27 | 13.53 | 11.67 |
| 2 CRUDE OIL & GAS (5-6) | 1.97 | 2.50 | 1.93 | 2.16 | 1.86 | 2.37 | 1.83 | 2.11 | 2.05 |
| 3 MINING (2-4,7) | 4.21 | 4.28 | 4.26 | 5.70 | 3.88 | 6.76 | 3.84 | 6.54 | 4.43 |
| 4 CONSTRUCTION (8) | 11.95 | 13.79 | 13.52 | 16.02 | 13.81 | 17.62 | 13.59 | 17.93 | 14.49 |
| NON-DURABLE GOODS | 22.15 | 23.89 | 22.82 | 26.26 | 25.52 | 28.43 | 27.51 | 25.81 | 27.99 |
| 5 FOOD, TOBACCO (9) | 3.98 | 4.20 | 3.89 | 4.42 | 4.37 | 4.78 | 4.84 | 4.55 | 5.21 |
| 6 TEXTILES (10) | 1.00 | 1.72 | 0.98 | 1.97 | 0.99 | 1.97 | 1.01 | 1.55 | 1.00 |
| 7 KNITTING (11) | 0.11 | 0.17 | 0.10 | 0.21 | 0.11 | 0.18 | 0.11 | 0.22 | 0.11 |
| 8 APPAREL & HHLD TEXTILES (12) | 0.61 | 0.75 | 0.65 | 0.87 | 0.79 | 0.94 | 0.91 | 0.92 | 0.99 |
| 9 PAPER (13) | 3.16 | 2.85 | 3.15 | 3.00 | 3.83 | 3.44 | 4.26 | 2.82 | 4.24 |
| 10 PRINTING (14) | 1.46 | 1.81 | 1.71 | 2.01 | 2.09 | 1.91 | 2.47 | 1.76 | 2.58 |
| 11 AGRICULTURAL FERTILIZER (15) | 1.10 | 1.00 | 1.20 | 1.32 | 1.36 | 1.62 | 1.51 | 1.91 | 1.42 |
| 12 OTHER CHEMICALS (16) | 7.40 | 7.61 | 7.63 | 8.55 | 8.13 | 9.79 | 8.51 | 8.41 | 8.34 |
| 13 PETROLEUM REFINING (17) | 1.87 | 2.13 | 1.88 | 2.16 | 2.25 | 2.14 | 2.62 | 2.08 | 2.83 |
| 14 RUBBER & PLASTIC PROD (19-20) | 1.37 | 1.55 | 1.54 | 1.65 | 1.50 | 1.55 | 1.15 | 1.47 | 1.14 |
| 15 FOOTWEAR & LEATHER (21) | 0.09 | 0.10 | 0.09 | 0.10 | 0.11 | 0.11 | 0.12 | 0.11 | 0.13 |
| DURABLE GOODS | 22.17 | 24.77 | 22.61 | 27.89 | 25.14 | 28.74 | 25.41 | 24.87 | 26.92 |
| 16 LUMBER (22) | 1.31 | 1.76 | 1.45 | 1.94 | 1.36 | 1.66 | 1.43 | 1.35 | 1.64 |
| 17 FURNITURE (23) | 0.31 | 0.44 | 0.30 | 0.50 | 0.29 | 0.43 | 0.31 | 0.36 | 0.37 |
| 18 STONE, CLAY & GLASS (24) | 1.64 | 1.77 | 1.97 | 1.81 | 2.30 | 1.66 | 2.00 | 1.42 | 1.65 |
| 19 IRON & STEEL (25) | 2.98 | 2.01 | 2.48 | 2.31 | 2.51 | 2.67 | 2.44 | 2.71 | 2.10 |
| 20 NON-FERROUS METALS (26-27) | 0.78 | 1.01 | 0.73 | 1.49 | 0.76 | 1.70 | 0.87 | 1.58 | 1.02 |
| 21 METAL PRODUCTS (28) | 2.17 | 2.34 | 2.16 | 2.65 | 2.05 | 2.61 | 1.81 | 2.27 | 1.77 |
| 22 ENGINES & TURBINES (29) | 0.31 | 0.32 | 0.28 | 0.35 | 0.39 | 0.41 | 0.40 | 0.37 | 0.47 |
| 23 AGRICULTURAL MACHINERY (30) | 0.35 | 0.41 | 0.36 | 0.37 | 0.44 | 0.43 | 0.44 | 0.48 | 0.50 |
| 25 METALWORKING MACHINERY (32) | 0.44 | 0.45 | 0.43 | 0.53 | 0.48 | 0.58 | 0.52 | 0.53 | 0.54 |
| 27 SPECIAL IND MACH (33) | 0.23 | 0.18 | 0.22 | 0.25 | 0.26 | 0.24 | 0.28 | 0.22 | 0.30 |
| 28 MISC NONELEC MACH (31,34) | 1.73 | 1.81 | 1.83 | 2.13 | 2.28 | 2.66 | 2.27 | 2.90 | 2.57 |
| 29 COMPUTERS, OFFICE EQ (35-36) | 0.79 | 0.90 | 0.93 | 1.00 | 1.09 | 1.13 | 1.07 | 1.06 | 1.20 |
| 30 SERVICE INDUSTRY MACH (37) | 0.28 | 0.40 | 0.26 | 0.48 | 0.35 | 0.48 | 0.35 | 0.45 | 0.41 |
| 31 COMMUNIC EQ, ELECTRON COMP (38) | 1.61 | 2.17 | 1.51 | 2.42 | 2.00 | 2.74 | 2.03 | 2.25 | 2.35 |
| 32 ELEC APP & DISTRIB EQ (39) | 0.59 | 0.62 | 0.63 | 0.82 | 0.69 | 0.95 | 0.72 | 1.02 | 0.78 |
| 33 HOUSEHOLD APPLIANCES (40) | 0.21 | 0.28 | 0.20 | 0.35 | 0.23 | 0.33 | 0.25 | 0.30 | 0.27 |
| 34 ELEC LIGHT & WIRING EQ (41) | 0.58 | 0.76 | 0.62 | 0.71 | 0.70 | 0.61 | 0.75 | 0.47 | 0.81 |
| 35 TV SETS, RADIOS, PHONOGRAPH (42) | 0.14 | 0.27 | 0.14 | 0.33 | 0.17 | 0.35 | 0.18 | 0.29 | 0.20 |
| 36 MOTOR VEHICLES (43) | 3.21 | 3.97 | 3.25 | 4.26 | 3.32 | 3.44 | 3.27 | 1.43 | 3.67 |
| 37 AEROSPACE (44) | 0.91 | 0.92 | 1.13 | 1.15 | 1.65 | 1.42 | 2.06 | 1.54 | 2.19 |
| 38 SHIPS & BOATS (45) | 0.15 | 0.21 | 0.15 | 0.25 | 0.16 | 0.32 | 0.18 | 0.37 | 0.18 |
| 39 OTHER TRANSP EQ (46) | 0.12 | 0.12 | 0.13 | 0.12 | 0.14 | 0.10 | 0.14 | 0.11 | 0.14 |
| 40 INSTRUMENTS (47) | 0.87 | 0.99 | 0.99 | 0.98 | 1.12 | 1.12 | 1.19 | 0.83 | 1.28 |
| 41 MISC MANUFACTURING (48) | 0.45 | 0.67 | 0.45 | 0.67 | 0.42 | 0.71 | 0.44 | 0.57 | 0.51 |
| TRANSPORTATION | 11.26 | 14.00 | 11.14 | 17.76 | 11.22 | 18.31 | 9.06 | 16.39 | 8.31 |
| 42 RAILROADS (49) | 3.63 | 3.97 | 4.28 | 4.65 | 4.31 | 4.62 | 4.00 | 3.79 | 3.92 |
| 43 AIR TRANSPORT (52) | 2.44 | 3.33 | 3.14 | 4.15 | 3.54 | 3.72 | 3.14 | 2.89 | 3.04 |
| 44 TRUCKING, OTH TRANS(50-51,53-54) | 5.19 | 6.70 | 3.72 | 8.97 | 3.37 | 9.96 | 1.92 | 9.71 | 1.35 |

TABLE 1 (continued)

PRODUCERS' DURABLE EQUIPMENT INVESTMENT (BILLIONS OF 1977$)

| | ( BASE) 1977 | ( BASE) 1978 | ( ALT1) 1978 | ( BASE) 1979 | ( ALT1) 1979 | ( BASE) 1980 | ( ALT1) 1980 | ( BASE) 1981 | ( ALT1) 1981 |
|---|---|---|---|---|---|---|---|---|---|
| UTILITIES | 16.71 | 18.28 | 17.89 | 21.48 | 18.44 | 21.26 | 17.78 | 19.02 | 18.61 |
| 45 COMMUNICATIONS SERVICES (55) | 8.86 | 10.74 | 9.88 | 11.72 | 10.57 | 11.28 | 10.60 | 10.57 | 11.39 |
| 46 ELECTRIC UTILITIES (56) | 5.71 | 5.10 | 5.51 | 6.90 | 5.63 | 7.17 | 5.15 | 5.76 | 5.20 |
| 47 GAS, WATER & SANITATION (57, 58) | 2.14 | 2.44 | 2.50 | 2.86 | 2.25 | 2.81 | 2.02 | 2.70 | 2.03 |
| 48 WHOLESALE & RETAIL TRADE (59, 60) | 15.14 | 17.79 | 16.75 | 19.49 | 18.27 | 18.57 | 16.13 | 17.70 | 15.43 |
| FINANCE, INSURANCE, REAL EST. | 8.97 | 11.50 | 11.33 | 12.65 | 12.62 | 13.32 | 12.05 | 13.05 | 13.07 |
| 49 FINANCE & INSURANCE (62) | 3.96 | 4.86 | 4.73 | 5.27 | 5.26 | 5.84 | 4.89 | 6.05 | 5.91 |
| 50 REAL ESTATE (63) | 5.01 | 6.64 | 6.60 | 7.38 | 7.36 | 7.48 | 7.17 | 7.01 | 7.16 |
| SERVICES | 18.91 | 21.35 | 21.56 | 22.65 | 23.37 | 22.39 | 21.84 | 22.40 | 22.30 |
| 51 HOTELS; REPAIRS EXC. AUTO (65) | 3.26 | 3.92 | 3.71 | 4.34 | 4.09 | 4.32 | 3.84 | 4.31 | 3.88 |
| 52 BUSINESS SERVICES (66) | 5.10 | 6.54 | 6.27 | 6.96 | 6.96 | 6.71 | 6.44 | 6.47 | 6.41 |
| 53 AUTO REPAIR (67) | 2.26 | 2.40 | 2.37 | 2.70 | 2.57 | 2.58 | 2.43 | 2.64 | 2.54 |
| 54 MOVIES & AMUSEMENTS (68) | 1.87 | 2.22 | 2.35 | 2.29 | 2.45 | 2.50 | 2.27 | 2.42 | 2.29 |
| 55 MEDICINE, EDUC, NPO (69) | 6.42 | 6.27 | 6.86 | 6.37 | 7.30 | 6.27 | 6.86 | 6.56 | 7.17 |
| MISCELLANEOUS | 5.57 | -1.67 | -1.72 | -3.71 | -3.71 | -3.77 | -3.77 | -3.01 | -3.00 |
| 56 PERSONAL AUTOS | 5.57 | 5.66 | 5.61 | 4.94 | 4.94 | 3.89 | 3.89 | 4.65 | 4.65 |
| 57 SALES OF USED EQUIP | | | | | | | | | |

# TABLE 2
## HOURLY ADJUSTED EMPLOYMENT (MILLIONS OF JOBS)

| | BASE | BASE | ALT1 | BASE | ALT1 | BASE | ALT1 | BASE | ALT1 |
|---|---|---|---|---|---|---|---|---|---|
| | 1977 | 1978 | 1978 | 1979 | 1979 | 1980 | 1980 | 1981 | 1981 |
| TOTAL PRIVATE SECTOR JOBS | 78.53 | 81.51 | 82.90 | 84.18 | 86.17 | 83.92 | 86.79 | 83.73 | 87.06 |
| AGRIC, MINING, CONSTRUCTION | 8.88 | 10.26 | 9.61 | 10.29 | 10.03 | 10.23 | 9.92 | 10.14 | 10 06 |
| 1 AGRICULTURE(1) | 3.30 | 3.59 | 3.37 | 3.48 | 3.35 | 3.43 | 3.37 | 3 55 | 3.61 |
| 2 CRUDE OIL & GAS (5-6) | 0.39 | 0.43 | 0.44 | 0.46 | 0.49 | 0.60 | 0.56 | 0.53 | 0.54 |
| 3 MINING (2-4,7) | 0.46 | 0.48 | 0.42 | 0.54 | 0.49 | 0.58 | 0.51 | 0.59 | 0.52 |
| 4 CONSTRUCTION (8) | 4.73 | 5.76 | 5.38 | 5.81 | 5.70 | 5.62 | 5.49 | 5.47 | 5.39 |
| NON-DURABLE GOODS | 8.09 | 8.18 | 8.37 | 8.28 | 8.30 | 7.85 | 8.15 | 7.53 | 8.00 |
| 5 FOOD, TOBACCO (9) | 1.79 | 1.76 | 1.83 | 1.75 | 1.80 | 1.72 | 1.76 | 1.73 | 1.77 |
| 6 TEXTILES (10) | 0.67 | 0.71 | 0.67 | 0.70 | 0.65 | 0.55 | 0.63 | 0.43 | 0.58 |
| 7 KNITTING (11) | 0 23 | 0.23 | 0.24 | 0.23 | 0.23 | 0.22 | 0.23 | 0.21 | 0.23 |
| 8 APPAREL & HHLD TEXTILES (12) | 1.31 | 1.38 | 1.35 | 1.43 | 1.30 | 1.39 | 1.29 | 1.41 | 1.26 |
| 9 PAPER (13) | 0.69 | 0.69 | 0.71 | 0.70 | 0.71 | 0.68 | 0.69 | 0.67 | 0.67 |
| 10 PRINTING (14) | 1.15 | 1.19 | 1.22 | 1.13 | 1.25 | 0.96 | 1.28 | 0.82 | 1.25 |
| 11 AGRICULTURAL FERTILIZER (15) | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 | 0.08 | 0.07 | 0.07 | 0.07 |
| 12 OTHER CHEMICALS (16) | 1.01 | 1.01 | 1.05 | 1.09 | 1.05 | 1.06 | 1.05 | 1.04 | 1.03 |
| 13 PETROLEUM REFINING (17) | 0.20 | 0.20 | 0.21 | 0.20 | 0.21 | 0.20 | 0.20 | 0.19 | 0.18 |
| 14 RUBBER & PLASTIC PROD (19-20) | 0.71 | 0.72 | 0.76 | 0.76 | 0.77 | 0.78 | 0.71 | 0.73 | 0.72 |
| 15 FOOTWEAR & LEATHER (21) | 0.25 | 0.23 | 0.26 | 0.22 | 0.25 | 0.22 | 0.24 | 0.22 | 0.23 |
| DURABLE GOODS | 11.64 | 11.75 | 12.50 | 12.29 | 12.77 | 11.64 | 12.24 | 11.15 | 12.08 |
| 16 LUMBER (22) | 0.72 | 0.70 | 0.76 | 0.69 | 0.76 | 0.60 | 0.68 | 0.57 | 0.65 |
| 17 FURNITURE (23) | 0.46 | 0.48 | 0.50 | 0.51 | 0.50 | 0.46 | 0.47 | 0.45 | 0.46 |
| 18 STONE, CLAY & GLASS (24) | 0.67 | 0.66 | 0.71 | 0.68 | 0.71 | 0.64 | 0.67 | 0.61 | 0.64 |
| 19 IRON & STEEL (25) | 0.78 | 0.79 | 0.81 | 0.84 | 0.81 | 0.80 | 0.71 | 0.77 | 0.70 |
| 20 NON-FERROUS METALS (26-27) | 0.40 | 0.40 | 0.42 | 0.44 | 0.44 | 0.45 | 0.42 | 0.39 | 0.40 |
| 21 METAL PRODUCTS (28) | 1.59 | 1.65 | 1.70 | 1.70 | 1.72 | 1.66 | 1.63 | 1.71 | 1.64 |
| 22 ENGINES & TURBINES (29) | 0.12 | 0.10 | 0.14 | 0.12 | 0.14 | 0.15 | 0.13 | 0.14 | 0.13 |
| 23 AGRICULTURAL MACHINERY (30) | 0.15 | 0.16 | 0.17 | 0.16 | 0.17 | 0.16 | 0.15 | 0.14 | 0.14 |
| 25 METALWORKING MACHINERY (32) | 0.33 | 0.34 | 0.35 | 0.38 | 0.37 | 0.37 | 0.37 | 0.33 | 0.38 |
| 27 SPECIAL IND MACH (33) | 0.19 | 0.20 | 0.20 | 0.21 | 0.21 | 0.17 | 0.21 | 0.16 | 0.21 |
| 28 MISC NONELEC MACH (31,34) | 0.93 | 0.96 | 0.97 | 1.09 | 0.99 | 1.19 | 1.06 | 1.14 | 1.08 |
| 29 COMPUTERS, OFFICE EQ (35-36) | 0.32 | 0.30 | 0.36 | 0.31 | 0.40 | 0.31 | 0.42 | 0.26 | 0.41 |
| 30 SERVICE INDUSTRY MACH (37) | 0.17 | 0.18 | 0.19 | 0.20 | 0.19 | 0.19 | 0.17 | 0.20 | 0.17 |
| 31 COMMUNIC EQ, ELECTRON COMP (38) | 0.86 | 0.84 | 0.98 | 0.91 | 1.07 | 0.81 | 1.10 | 0.77 | 1.13 |
| 32 ELEC APP & DISTRIB EQ (39) | 0.35 | 0.37 | 0.37 | 0.38 | 0.38 | 0.35 | 0.36 | 0.37 | 0.35 |
| 33 HOUSEHOLD APPLIANCES (40) | 0.18 | 0.19 | 0.19 | 0.18 | 0.18 | 0.15 | 0.17 | 0.18 | 0.17 |
| 34 ELEC LIGHT & WIRING EQ (41) | 0.36 | 0.34 | 0.38 | 0.38 | 0.39 | 0.39 | 0.37 | 0.37 | 0.37 |
| 35 TV SETS, RADIOS, PHONOGRAPH (42) | 0.12 | 0.13 | 0.11 | 0.15 | 0.11 | 0.15 | 0.10 | 0.15 | 0.10 |
| 36 MOTOR VEHICLES (43) | 0.95 | 0.89 | 1.02 | 0.83 | 0.99 | 0.65 | 0.77 | 0.57 | 0.74 |
| 37 AEROSPACE (44) | 0.49 | 0.54 | 0.54 | 0.60 | 0.62 | 0.66 | 0.67 | 0.66 | 0.71 |
| 38 SHIPS & BOATS (45) | 0.22 | 0.22 | 0.23 | 0.24 | 0.22 | 0.24 | 0.21 | 0.24 | 0.21 |
| 39 OTHER TRANSP EQ (46) | 0.22 | 0.23 | 0.25 | 0.20 | 0.25 | 0.13 | 0.23 | 0.09 | 0.22 |
| 40 INSTRUMENTS (47) | 0.62 | 0.61 | 0.67 | 0.61 | 0.69 | 0.53 | 0.71 | 0.46 | 0.67 |
| 41 MISC MANUFACTURING (48) | 0.44 | 0.48 | 0.46 | 0.48 | 0.45 | 0.44 | 0.42 | 0.41 | 0.40 |
| TRANSPORTATION | 2.98 | 3.05 | 3.14 | 3.16 | 3.27 | 3.16 | 3.20 | 3.17 | 3.11 |
| 42 RAILROADS (49) | 0.53 | 0.54 | 0.53 | 0.57 | 0.54 | 0.58 | 0.52 | 0.56 | 0 50 |
| 43 AIR TRANSPORT (52) | 0.39 | 0.42 | 0.41 | 0.43 | 0.44 | 0.45 | 0.46 | 0.47 | 0.44 |
| 44 TRUCKING, OTH TRANS(50-51,53-54) | 2.05 | 2.10 | 2.20 | 2.16 | 2.29 | 2.13 | 2.22 | 2.13 | 2.17 |

## TABLE 2 (continued)

ADJUSTED EMPLOYMENT (MILLIONS OF JOBS)

| | ( BASE) 1977 | ( BASE) 1978 | ( ALT1) 1978 | ( BASE) 1979 | ( ALT1) 1979 | ( BASE) 1980 | ( ALT1) 1980 | ( BASE) 1981 | ( ALT1) 1981 |
|---|---|---|---|---|---|---|---|---|---|
| UTILITIES | 1.94 | 1.99 | 2.02 | 2.02 | 2.13 | 1.99 | 2.20 | 1.96 | 2.22 |
| 45 COMMUNICATIONS SERVICES (55) | 1.19 | 1.23 | 1.24 | 1.26 | 1.32 | 1.22 | 1.36 | 1.19 | 1.39 |
| 46 ELECTRIC UTILITIES (56) | 0.51 | 0.51 | 0.55 | 0.51 | 0.57 | 0.50 | 0.57 | 0.50 | 0.57 |
| 47 GAS, WATER & SANITATION (57, 58) | 0.24 | 0.24 | 0.23 | 0.26 | 0.24 | 0.26 | 0.26 | 0.27 | 0.26 |
| 48 WHOLESALE & RETAIL TRADE (59, 60) | 20.38 | 20.85 | 21.43 | 21.53 | 22.31 | 21.92 | 22.65 | 21.93 | 22.79 |
| FINANCE, INSURANCE, REAL EST. | 4.91 | 5.19 | 5.24 | 5.45 | 5.50 | 5.57 | 5.71 | 5.70 | 5.84 |
| 49 FINANCE & INSURANCE (62) | 3.67 | 3.82 | 3.89 | 3.97 | 4.03 | 4.09 | 4.18 | 4.21 | 4.31 |
| 50 REAL ESTATE (63) | 1.25 | 1.36 | 1.36 | 1.48 | 1.46 | 1.48 | 1.53 | 1.49 | 1.52 |
| SERVICES | 17.79 | 18.32 | 18.66 | 19.25 | 19.94 | 19.66 | 20.83 | 20.28 | 21.09 |
| 51 HOTELS; REPAIRS EXC. AUTO (65) | 3.06 | 3.16 | 3.15 | 3.21 | 3.33 | 3.15 | 3.48 | 3.19 | 3.51 |
| 52 BUSINESS SERVICES (66) | 4.25 | 4.37 | 4.69 | 4.64 | 5.11 | 4.69 | 5.43 | 4.75 | 5.50 |
| 53 AUTO REPAIR (67) | 0.71 | 0.77 | 0.77 | 0.82 | 0.83 | 0.84 | 0.85 | 0.84 | 0.86 |
| 54 MOVIES & AMUSEMENTS (68) | 1.01 | 1.10 | 1.03 | 1.19 | 1.06 | 1.22 | 1.09 | 1.29 | 1.12 |
| 55 MEDICINE, EDUC, NPO (69) | 8.75 | 8.92 | 9.02 | 9.37 | 9.60 | 9.76 | 9.99 | 10.22 | 10.09 |
| DOMESTIC SERVANTS | 1.92 | 1.92 | 1.92 | 1.91 | 1.91 | 1.89 | 1.89 | 1.88 | 1.88 |
| CIVILIAN GOVERNMENT | 15.51 | 15.88 | 15.88 | 16.23 | 16.23 | 16.55 | 16.55 | 16.21 | 16.56 |
| FEDERAL DEFENSE | 0.98 | 0.98 | 0.98 | 0.96 | 0.96 | 0.96 | 0.96 | 0.96 | 0.96 |
| FEDERAL NON-DEFENSE | 1.10 | 1.06 | 1.06 | 1.15 | 1.15 | 1.24 | 1.24 | 1.00 | 1.13 |
| STATE & LOCAL EDUCATION | 6.56 | 6.69 | 6.69 | 6.80 | 6.80 | 6.85 | 6.85 | 6.89 | 6.89 |
| STATE & LOCAL OTHER | 5.37 | 5.61 | 5.61 | 5.74 | 5.74 | 5.89 | 5.89 | 5.70 | 5.92 |
| FEDERAL GOVT ENTERPRISES | 0.84 | 0.86 | 0.86 | 0.89 | 0.89 | 0.91 | 0.91 | 0.93 | 0.93 |
| STATE & LOCAL GOVT ENTERPRISES | 0.66 | 0.68 | 0.68 | 0.69 | 0.69 | 0.71 | 0.71 | 0.72 | 0.72 |
| TOTAL CIVILIAN JOBS | 94.04 | 97.40 | 98.78 | 100.42 | 102.41 | 100.47 | 103.35 | 99.94 | 103.62 |
| TOTAL CIVILIAN EMPLOYMENT | 90.60 | 92.98 | 94.36 | 94.99 | 96.98 | 94.26 | 97.13 | 94.15 | 97.82 |
| MULTIPLE JOB HOLDERS | 3.44 | 4.42 | 4.42 | 5.43 | 5.43 | 6.21 | 6.21 | 5.80 | 5.80 |
| MILITARY JOBS | 2.07 | 2.06 | 2.06 | 2.08 | 2.08 | 2.10 | 2.10 | 2.14 | 2.10 |
| CIVILIAN UNEMPLOYMENT RATE | 7.00 | 7.43 | 6.06 | 7.78 | 5.85 | 10.01 | 7.26 | 11.55 | 8.09 |
| LABOR PRODUCTIVITY | | | | | | | | | |
| GNP / CIVILIAN JOBS | 20.40 | 20.71 | 20.31 | 20.98 | 20.38 | 21.22 | 20.28 | 21.65 | 20.80 |
| (GNP-GOVT) / PRIVATE JOBS | 18.58 | 19.04 | 18.60 | 19.39 | 18.70 | 19.58 | 18.54 | 20.09 | 19.16 |

1979, 1980 and 1981 are, respectively, 11.0, 19.3 and 9.1 percent.

It appears that most of the over-prediction may be traced to a few industries. For example, in 1978 only 16 of the 53 industry equations predicted less investment than actually occurred. Of the nine billion dollars in excess investment predicted for 1978, 33 percent of the excess may be traced to TRUCKING AND OTHER TRANSPORTATION (44), where predicted investment in 1978 is three billion dollars above actual. Other large sectors which have significant misses on the high side in 1978 are AGRICULTURE (1), GRUDE OIL AND GAS (2), COMMUNICATION EQUIPMENT (31), COMMUNICATION SERVICES (45), WHOLESALE AND RETAIL TRADE (48), and TEXTILES (6). Combining these sectors with TRUCKING (44) accounts for 83 percent of the over-prediction in 1978. Among the large industries which severly under-predict investment in 1978 are PAPER (9), AGRICULTURE FERTILIZERS (11), IRON & STEEL (19) and AEROSPACE (37), with a combined error of -.1.18 billion, or an APE of 14.8.

The highest miss at the aggregate level occurs in 1980, in which the equations over predict by 30.56 billion dollars in investment. Over 25 percent of this error may be accounted for by TRUCKING AND TRANSPORT (44). In that sector, the equation forecasts 9.96 billion dollars in investment compared to actual investment of 1.92 billion. Among the other industries in which a significant excess of investment is predicted in 1980 are: AGRICULTURE (1), MINING (3), CONSTRUCTION (4), OTHER CHEMICALS (12), COMMUNICATION EQUIPMENT (31), ELECTRIC UTILITIES (46), WHOLESALE AND RETAIL TRADE (48), and FINANCE AND INSURANCE (49), which together with TRUCKING (44) account for 25.21 billion dollars in excess investment. Among the larger industries in which investment is significantly under-predicted in 1980 are: PAPER (9), PRINTING (10),

STONE, CLAY AND GLASS (18), AEROSPACE (37), and PETROLEUM REFINING (13).

As we saw in the previous chapter, investment by industry is determined by relative price movements and changes in demand. So the question is: What properties of the investment equation appear to be responsible for the poor performance of the model in a number of industries? A clue may be found in Table 5 of Chapter 5. As we have already mentioned, the industry which does poorest in the forecast is TRUCKING AND OTHER TRANSPORTATION (44). As Table 5 in Chapter 5 shows, however, this equation is very insensitive to relative price movements. This insensitivity suggests that the assumption of constant returns to scale (CRS) in the trucking industry was, perhaps, inappropriate. The second poorest equation is CONSTRUCTION (4), which shows greater sensitivity to relative prices: $E_{KE}$ .216, for example. Consequently, much predicted investment appears to be generated by relatively more expensive energy prices (see the tables in Appendix C); however, constant returns to scale may be inappropriate in this industry as well. An additional example of where CRS may be responsible for the poor forecasts is ELECTRIC UTILITIES (46), which over predicts in 1980 by nearly 40 percent, yet all estimated price elasticities are essentially zero. Finally, WHOLESALE AND RETAIL TRADE (48) provides a final example of where CRS may have been inappropriate. Although price elasticites are not zero, the one which is of most interest, $E_{KE}$, is extremely small, .05. The two billion dollar over-prediction in this industry again suggests that CRS may be wrong for this industry.

The effect of relative prices on investment do not appear, consequently, to be a decisive factor in the poor forecasts through 1981. Looking at the tables in Appendix C, we see that, in most industries, labor is slightly more expensive relative to capital in 1980 as compared to 1977. Since all elasticities of substitution between capital and labor are required to be non-negative, the labor-capital relative price movements would lead to greater investment, for any given amount of industry demand. Energy prices are higher relative to the equipment price through 1980 as well. Since higher energy prices should lead to lower investment in most industries, it appears that the relative price affects might, to a certain extent, cancel out. Therefore, the driving force behind the investment forecasts is industry demand; and, it appears that non-constant returns to scale should be permitted for a number of industries.

In 1981, the performance of the investment equations at the aggregate level have improved relative to 1980. In fact, 60 percent of the over-prediction in 1981 may be attributed to one sector, TRUCKING AND OTHER TARANSPORTATION (44). The slowdown in investment is most likely occurring because energy prices are rising from 1978 through 1981.

Table 2 provides the employment forecasts as well as actual employment through 1981. An aggregate measure of performance may be observed in Table 3 which provides the predicted unemployment rate through 1983 using the estimated industry employment equations, and the actual undemployment rate from 1978 through 1981. The "actual" unemployment rate for 1982 is a guess based upon the experience of the first quarter of 1982. Most likely, the guess is on the low side.

Unemployment rate

| | BASE | ALT1 (Actual) |
|---|---|---|
| 1978 | 7.43 | 6.06 |
| 1979 | 7.78 | 5.85 |
| 1980 | 10.01 | 7.26 |
| 1981 | 11.55 | 8.09 |
| 1982 | 10.76 | 9.00 |
| 1983 | 8.86 | * |

Table 3

As may be seen, the industry equations predict excessive unemployment from 1978 through 1982.

As table 2 shows, in the first year of the forecast, employment is under-predicted by over 1.39 million workers. By 1981, the under-prediction is approximately 3.3 million workers. The APE at the aggregate level from 1978 through 1981 are 1.7, 2.3, 3.2 and 3.8, respectively.

Over 40 percent of the underprediction in 1978 is due to WHOLESALE & RETAIL TRADE (48), which predicts .58 million less employment than actual. Almost all of the remainder of the under- prediction is distributed among the durable goods industries, which account for an additional under-prediction of .75 million in 1978. The most conspicuous of these equations is MOTOR VEHICLES (36), which under-predicts by .13 million, with an APE of 12.7. In total, 35 industry equations under-predict employment in 1978.

In 1981, WHOLESALE & RETAIL TRADE accounts for .86 million of the under- prediction. In addition, BUSINESS SERVICES (52) accounts for .75 million too few workers. Consequently, these two equations, combined, account for nearly 50 percent of the error in 1981. Three additional equations which significantly under-predict employment in 1981 are COMMUNICATIONS EQUIPMENT (31), MOTOR VEHICLES (36) and PRINTING (10), which have a combined error of .96 millionn. In total, 29 industries predict less employment and higher productivity in 1981 than actually occurred.

The implications of the employment forecasts for productivity growth at the aggregate level may be seen in Table 4; while the implied productivity growth rates at the industry level are shown in Table B4 in Appendix B.

Aggregate Productivity Growth

| | BASE | ALT1 |
|---|---|---|
| 1977-78 | 1.49 | -0.43 |
| 1978-79 | 1.33 | 0.31 |
| 1979-80 | 1.11 | -0.45 |
| 1980-81 | 2.03 | 2.50 |
| 1981-82 | 1.11 | * |
| 1982-83 | 2.24 | * |
| 1977-81 | 1.49 | 0.48 |

Table 4

Table 4 shows that predicted productivity growth at the aggregate level is higher than actual in each year of the forecast except 1980-81.

Over the 1977-81 period, the equations over-predicted productivity by an average of one percent per year (1.49 to 0.48) at the aggregate level.

Looking at the last column of Table B4, we see that there were 19 industries which experienced declining productivity from 1977 through 1981. Of those 19 industries, the equations correctly predicted that eight would have declining productivity over that period. The equation which did the worst over this period was OTHER TRANSPORTATION EQUIPMENT (39) which predicted an annual productivity growth of 21.95 percent over the 1977-81 period, while productivity actually declined during that period at a rate of -2.59 percent per year. An additional equation which performed poorly was PRINTING (10), with a predicted growth in productivity of 10.29 percent per year, while actual productivity was declining -0.69 percent per year. Among the industries which do well over the forecast period are ENGINES & TURBINES (22), APPAREL AND HOUSEHOLD TEXTILES (8), PAPER (9), and OTHER CHEMICALS (12). Among the big employers, FINANCE AND INSURANCE (49) performs best, with a predicted annual productivity growth over the period of 0.71 compared to an actual annual productivity growth of 0.47. The biggest employer, WHOLESALE AND RETAIL TRADE (48), experienced a decline in productivity of 0.19 percent per year, while the equation predicted a positive growth of .90 percent per year. In total, only 14 industry equations predict lower productivity growth over the 1977-81 period than actually occurred. Finally, it appears clear that the worst year of the forecast from the point of view of productivity growth is the first year, 1978. In that year, the equations predicted the correct sign on the productivity growth rate in only 22 industries. The corresponding numbers for 1979,1980, and 1981 are 35,32 and 44 respectively.

Why have some employment equations performed well while others have done poorly over the 1977-81 period? A look at two large sectors with equations which performed below expectations may provide some insight into the question. The largest industry employer is WHOLESALE & RETAIL TRADE (48), which accounts for over 25 percent of all individuals employed in the United States. According to Table 5 in Chapter 5, employment in this industry is not insensitive to relative prices. In addition, we see from the price tables in Appendix C that the price of capital relative to wages stays approximately constant over the 1977-81 period, and that the price of energy relative to wages fluctuates noticably over the forecast. In 1978, the price of energy relative to wages actually drops; then, it grows precipitously during the 1979-81 period relative to the wage rate. Consequently, the relative price which plays an important role in the employment foreasts for WHOLESALE & RETAIL TRADE is the energy-wage relative price. Accordingly, the lower energy price in 1978 helps generate a productivity forecast for that year of three percent growth, while actual productivity declined -.15 percent. By 1980, once the higher energy price has entered the equation, predicted and actual productivity growth are much closer: -1.92 for the predicted compared to -2.31 for actual. These results suggest that the estimated relationship between energy prices and employment in this industry is partly responsible for its poor performance in 1978, but also partly responsible for its improved performance in 1980. These results also suggest that the addition of the 1978 data into the estimation might significantly change the energy price variable in the employment equation for this industry.

A second large industry which performs poorly is BUSINESS SERVICES

(52), which, as we have said, under-predicts employment throughout the forecast. However, for this industry all relative price elasticities for labor are essentially zero ( see Table 5 in Chapter 5); so that employment is determined almost exclusively by a time trend. The estimated trend growth in productivity for BUSINESS SERVICES is 1.08 percent over the history, as the table in Appendix A of Chapter 5 shows. In addition, there was no estimated slowdown in the trend after 1970. Consequently, all we can say is that since 1978, the trend in productivity growth slowed, and that the factors which caused this slowdown were not captured in the employment equation. Again, BUSINESS SERVICES performed worse in 1978 in which it predicted 3.83 percent growth in productivity while there was an actual decline of -3.75 percent.

As these two examples show, there is not one explanation for the poor forecasting performance of the industry equations. For WHOLESALE & RETAIL TRADE, the performance appears to be related to the manner in which energy prices enter the equation. Perhaps a different lag structure on the energy price variable would provide better results. For BUSINESS SERVICES, it is simply the case that the only explainer in the model, time, does not have the same relationship to employment in 1978 as it did prior to 1978. It is clear that an additional year of data would change the results of each equation.

Two equations which did remarkedly well in 1978 were AEROSPACE (37) and REAL ESTATE (50). The predicted productivity growth in 1978 for AEROSPACE is -1.32 while actual growth is -1.33. The corresponding growth rates for REAL ESTATE are -4.79 and -4.48. In each case, however, the equation implies that productivity growth since 1970 has been negative. We must admit that these negative trends are mostly responsible for the accurate predictions in 1978. Unfortunately, we can shed little light on the causes for the negative trends.

## 4. Summary and Assessment

The performance of the investment and employment equations over the 1977-81 period are short of expectations. The investment equations tend to generate too much investment while the employment equations generate, on the whole, too little employment and too much productivity. The recommended modifications to the investment equations are manageable and straight forward. First, a relaxation of the constant returns to scale assumption might correct some of the over-prediction. Our belief that this modification will improve the forecasts is based upon the finding that many sector equations which over-predict investment are highly insensitive to relative prices; so, price parameters may not be blamed for the equations' poor performance. Second, TRUCKING (44) alone is responsible for a sizable portion of the forecast error; so special atention to this equation is called for.

Modifications to the employment equations are more problematical. For some equations, the solution might be simply to add a year of data. For others equations, the effort must continue to explain employment in some way other than a time trend. Perhaps with the introduction of an energy demand equation, more robust labor-energy price elasticities may be estimated which might, in turn, help generate accurate forecasts without resorting to the second time trend. Finally, there appears to be sufficient need to explore for additional explanatory variables which might be used to amend the existing model. It appears, for example, that the variables used in this study probably would not be sufficient to explain the drop in productivity in 1978, a year in which there was substantial real growth in the economy and declining energy prices. Although there does not appear to be any reason to reject the framework which this study has established, it is evident that the present model relies too heavily upon relative price movements and trend variables to explain and forecast employment and productivity.

## Appendix A

Table A1: Industries in the BEA Survey on Plant and Equipment

- TOTAL NONFARM BUSINESS
  - MANUFACTURING
    - DURABLE GOODS
      - PRIMARY METALS
        - BLAST FURNACES, STEEL WORKS
        - NONFERROUS METALS
      - FABRICATED METALS
      - ELECTRICAL MACHINERY
      - TRANSPORTATION EQUIPMENT
        - MOTOR VEHICLES
        - AIRCRAFT
      - STONE,CLAY,AND GLASS
      - OTHER DURABLES
    - NONDURABLE GOODS
      - FOOD INCLUDING BEVERAGE
      - TEXTILES
      - PAPER
      - CHEMICALS
      - PETROLEUM
      - RUBBER
      - OTHER NONDURABLES
  - NONMANUFACTURING
    - MINING
    - TRANSPORTATION
      - RAILROAD
      - AIR
      - OTHER
    - PUBLIC UTILITIES
      - ELECTRIC
      - GAS AND OTHER
    - TRADE AND SERVICES
      - WHOLESALE AND RETAIL TRADE
      - FINANCE,INSURANCE,AND REAL ESTATE
      - PERSONAL,BUSINESS,AND PROF.SERVICES
    - COMMUNICATION AND OTHER
      - COMMUNICATION
      - OTHER

Table A2: Industries for which the Survey distinguishes between plant and equipment

- TOTAL NONFARM BUSINESS
  - MANUFACTURING
    - DURABLE GOODS
    - NONDURABLE GOODS
  - NONMANUFACTURING
    - MINING
    - TRANSPORTATION
    - PUBLIC UTILITIES
    - TRADE AND SERVICES
    - COMMUNICATION

# FOOTNOTES

1. Tables A1 in Appendix A shows the titles of the industries for which Plant & Equipment numbers exist through 1981. Table A2 gives the titles of the industries in which the plant and equipment components of investment are distinguished.
2. The relative wage equations are the subject of Matt Hyle's forthcoming dissertation. By relative wages we mean the ratio of industry wages to an aggregate wage. The aggregate wage equations were estimated by Clopper Almon.
3. The consumption equations are the subject of Paul Devine's forthcoming dissertation.
4. The outputs for the investment and employment equations are aggregates of output sectors 1 through 69 in Appendix C. On the other hand, the tables in Appendix C display wage indexes for only 38 industries (excluding Private Households and various government sectors). Since it was impossible to disaggregate these indexes into the 53 sectors for the forecast, we simply matched up the 38 wage industries to the 53 investment and employment industries as closely as possible, and used the appropriate wage.

# REFERENCES

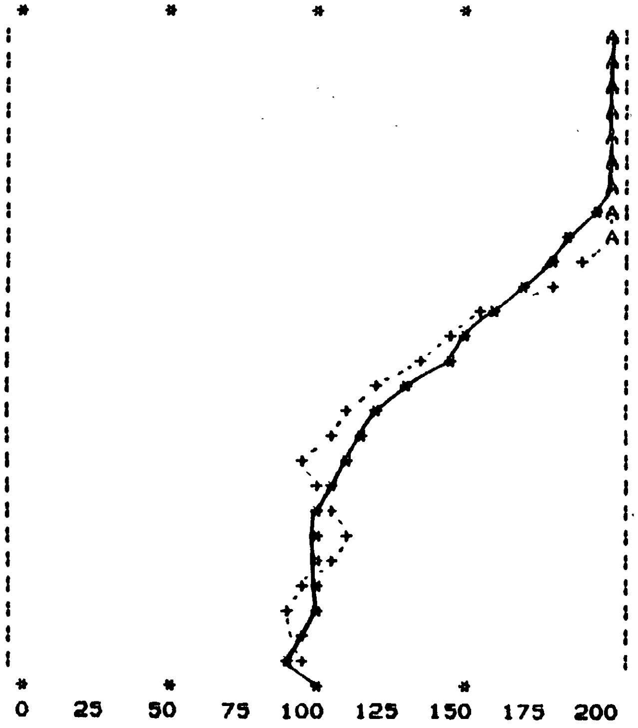
1. Almon, C., Buckler, M.B., Horwitz, L.M., and Reimbold, T.C., _1985 Interindustry Forecasts of the American Economy_, Lexington, Mass.: Lexington Books, 1974.

# APPENDIX C

## 1 FARMS AGR. SERVICES, FORESTRY, FISHERY

### EMPLOYMENT PER UNIT OF OUTPUT

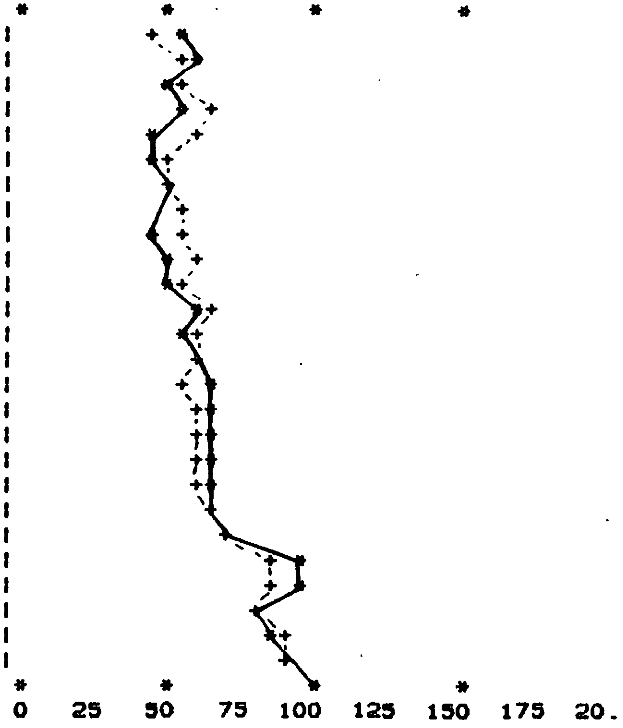
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 9.13 | 8.83 |
| 1953 | 8.52 | 8.16 |
| 1954 | 8.24 | 7.93 |
| 1955 | 7.73 | 7.62 |
| 1956 | 7.10 | 6.98 |
| 1957 | 6.53 | 6.80 |
| 1958 | 6.04 | 6.90 |
| 1959 | 5.69 | 6.29 |
| 1960 | 5.36 | 5.89 |
| 1961 | 5.18 | 5.49 |
| 1962 | 4.93 | 5.15 |
| 1963 | 4.59 | 4.44 |
| 1964 | 4.27 | 4.11 |
| 1965 | 4.10 | 3.86 |
| 1966 | 3.70 | 3.48 |
| 1967 | 3.38 | 3.21 |
| 1968 | 3.34 | 2.97 |
| 1969 | 3.18 | 2.74 |
| 1970 | 3.02 | 2.86 |
| 1971 | 2.80 | 3.04 |
| 1972 | 2.79 | 3.11 |
| 1973 | 2.87 | 2.92 |
| 1974 | 2.89 | 2.70 |
| 1975 | 2.86 | 2.54 |
| 1976 | 2.67 | 2.65 |
| 1977 | 2.60 | 2.75 |



1977 = 100%

### INVESTMENT

| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 6665.4 | 5338.3 |
| 1953 | 7472.4 | 6596.7 |
| 1954 | 6137.4 | 6411.3 |
| 1955 | 6823.2 | 7654.4 |
| 1956 | 5035.2 | 6973.7 |
| 1957 | 5159.9 | 5782.2 |
| 1958 | 6183.8 | 6097.3 |
| 1959 | 6625.4 | 6378.8 |
| 1960 | 5450.7 | 6643.7 |
| 1961 | 5905.8 | 7249.0 |
| 1962 | 6049.6 | 6864.1 |
| 1963 | 6998.9 | 7996.3 |
| 1964 | 6591.7 | 7045.2 |
| 1965 | 7345.4 | 7191.3 |
| 1966 | 7841.8 | 6667.1 |
| 1967 | 8091.7 | 7054.8 |
| 1968 | 7839.6 | 6985.4 |
| 1969 | 7653.2 | 7425.6 |
| 1970 | 7791.7 | 7454.1 |
| 1971 | 8167.4 | 7906.4 |
| 1972 | 8399.1 | 8480.9 |
| 1973 | 11740.3 | 10155.9 |
| 1974 | 11328.6 | 10318.3 |
| 1975 | 9582.6 | 10044.9 |
| 1976 | 10430.5 | 10983.7 |
| 1977 | 11172.0 | 10785.4 |

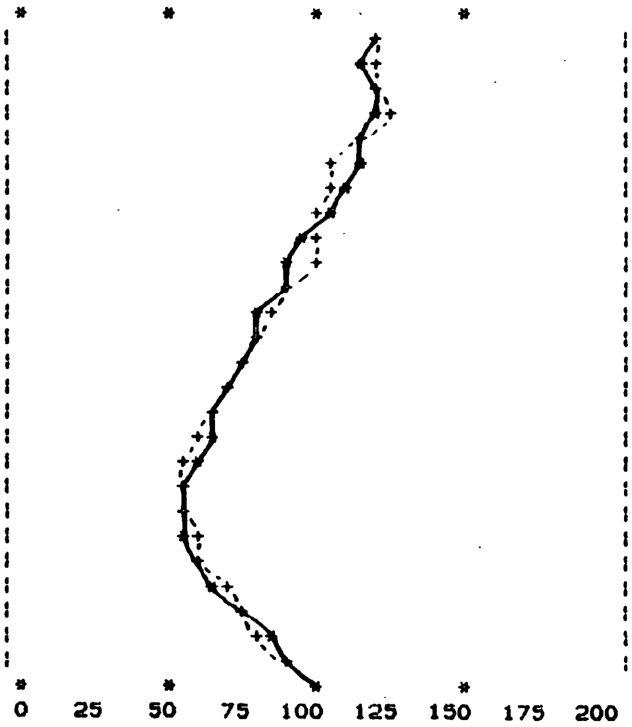


2 CRUDE PETROLEUM AND NATURAL GAS (4)

EMPLOYMENT PER UNIT OF OUTPUT

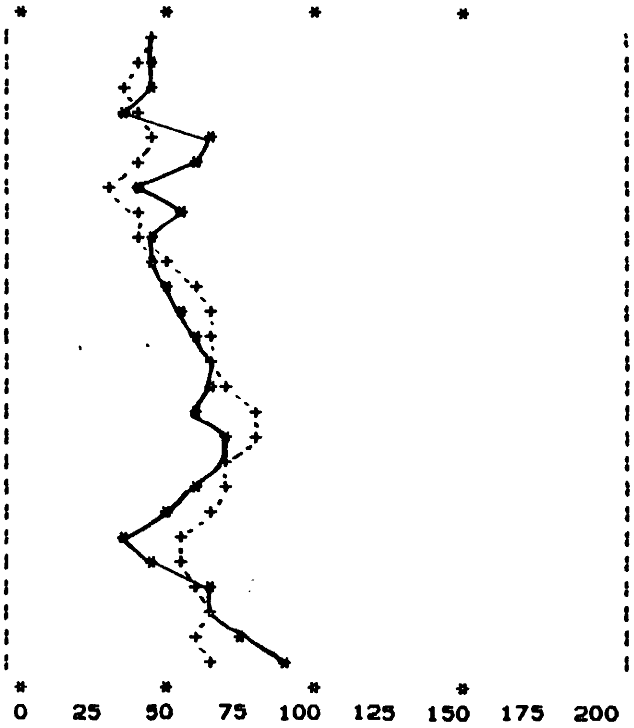
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 1.07 | 1.08 |
| 1953 | 1.06 | 1.07 |
| 1954 | 1.07 | 1.11 |
| 1955 | 1.10 | 1.13 |
| 1956 | 1.06 | 1.03 |
| 1957 | 1.04 | 0.97 |
| 1958 | 1.01 | 0.96 |
| 1959 | 0.96 | 0.92 |
| 1960 | 0.87 | 0.89 |
| 1961 | 0.83 | 0.88 |
| 1962 | 0.79 | 0.81 |
| 1963 | 0.74 | 0.78 |
| 1964 | 0.73 | 0.74 |
| 1965 | 0.68 | 0.69 |
| 1966 | 0.64 | 0.64 |
| 1967 | 0.59 | 0.59 |
| 1968 | 0.56 | 0.54 |
| 1969 | 0.55 | 0.49 |
| 1970 | 0.50 | 0.48 |
| 1971 | 0.49 | 0.51 |
| 1972 | 0.50 | 0.53 |
| 1973 | 0.52 | 0.54 |
| 1974 | 0.60 | 0.64 |
| 1975 | 0.69 | 0.69 |
| 1976 | 0.75 | 0.74 |
| 1977 | 0.82 | 0.79 |

1977 = 100%



INVESTMENT

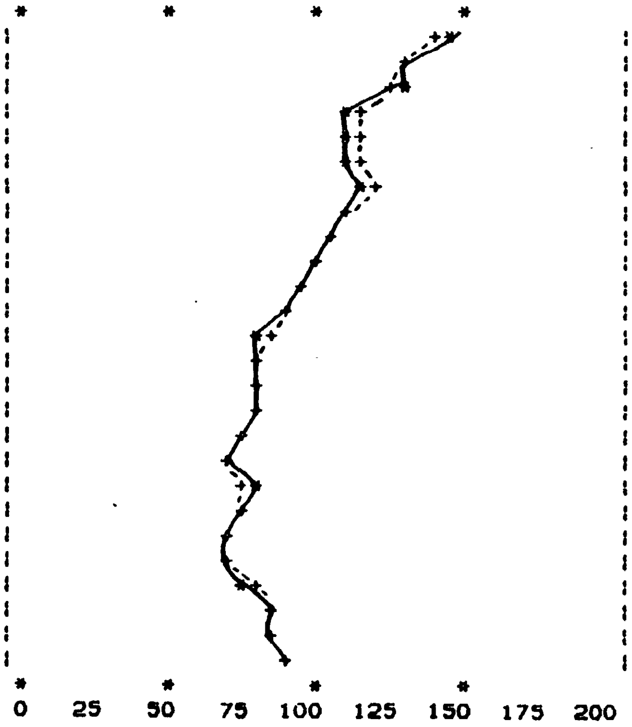
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 826.3 | 802.5 |
| 1953 | 792.0 | 658.7 |
| 1954 | 767.6 | 616.7 |
| 1955 | 559.5 | 724.3 |
| 1956 | 1114.7 | 786.4 |
| 1957 | 1022.6 | 653.4 |
| 1958 | 690.2 | 520.7 |
| 1959 | 947.9 | 722.9 |
| 1960 | 778.0 | 717.5 |
| 1961 | 810.9 | 870.7 |
| 1962 | 904.4 | 1048.5 |
| 1963 | 960.3 | 1129.0 |
| 1964 | 1040.5 | 1142.2 |
| 1965 | 1190.1 | 1119.3 |
| 1966 | 1132.8 | 1279.9 |
| 1967 | 1098.6 | 1472.5 |
| 1968 | 1220.6 | 1428.4 |
| 1969 | 1221.2 | 1241.9 |
| 1970 | 1102.9 | 1272.3 |
| 1971 | 903.5 | 1117.4 |
| 1972 | 582.8 | 944.3 |
| 1973 | 785.9 | 969.5 |
| 1974 | 1128.8 | 1065.1 |
| 1975 | 1177.4 | 1173.8 |
| 1976 | 1303.4 | 1087.5 |
| 1977 | 1640.3 | 1137.7 |



3 MINING (2,3,5)

## EMPLOYMENT PER UNIT OF OUTPUT

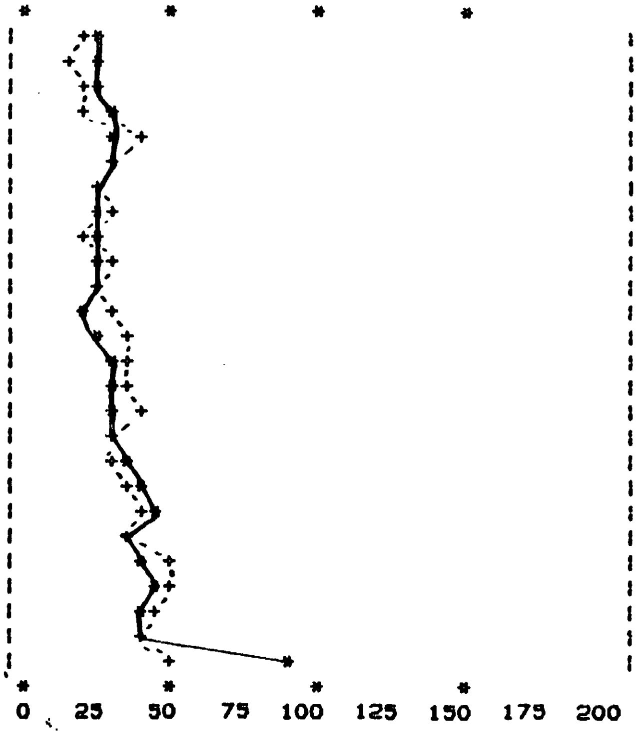
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 2.57 | 2.48 |
| 1953 | 2.34 | 2.32 |
| 1954 | 2.27 | 2.25 |
| 1955 | 1.96 | 2.01 |
| 1956 | 1.95 | 1.99 |
| 1957 | 1.94 | 2.05 |
| 1958 | 1.99 | 2.07 |
| 1959 | 1.98 | 1.91 |
| 1960 | 1.84 | 1.80 |
| 1961 | 1.77 | 1.74 |
| 1962 | 1.65 | 1.63 |
| 1963 | 1.54 | 1.55 |
| 1964 | 1.43 | 1.47 |
| 1965 | 1.39 | 1.44 |
| 1966 | 1.35 | 1.39 |
| 1967 | 1.38 | 1.36 |
| 1968 | 1.29 | 1.26 |
| 1969 | 1.26 | 1.23 |
| 1970 | 1.40 | 1.32 |
| 1971 | 1.28 | 1.27 |
| 1972 | 1.22 | 1.20 |
| 1973 | 1.22 | 1.21 |
| 1974 | 1.28 | 1.38 |
| 1975 | 1.46 | 1.46 |
| 1976 | 1.48 | 1.49 |
| 1977 | 1.60 | 1.56 |



1977 = 100%

## INVESTMENT

| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 1085.7 | 788.5 |
| 1953 | 1151.6 | 649.5 |
| 1954 | 1121.1 | 889.8 |
| 1955 | 1249.5 | 753.6 |
| 1956 | 1303.0 | 1714.0 |
| 1957 | 1290.4 | 1398.9 |
| 1958 | 1045.8 | 1169.7 |
| 1959 | 1054.4 | 1189.6 |
| 1960 | 971.8 | 869.4 |
| 1961 | 968.5 | 1353.5 |
| 1962 | 1041.8 | 976.2 |
| 1963 | 931.0 | 1185.6 |
| 1964 | 975.6 | 1582.8 |
| 1965 | 1210.0 | 1589.2 |
| 1966 | 1257.1 | 1601.1 |
| 1967 | 1329.3 | 1671.9 |
| 1968 | 1386.7 | 1248.7 |
| 1969 | 1540.5 | 1333.5 |
| 1970 | 1714.5 | 1615.6 |
| 1971 | 1898.2 | 1778.9 |
| 1972 | 1543.9 | 1605.2 |
| 1973 | 1810.7 | 2131.9 |
| 1974 | 1886.1 | 2201.3 |
| 1975 | 1702.9 | 1914.1 |
| 1976 | 1742.6 | 1823.4 |
| 1977 | 4162.1 | 2338.8 |

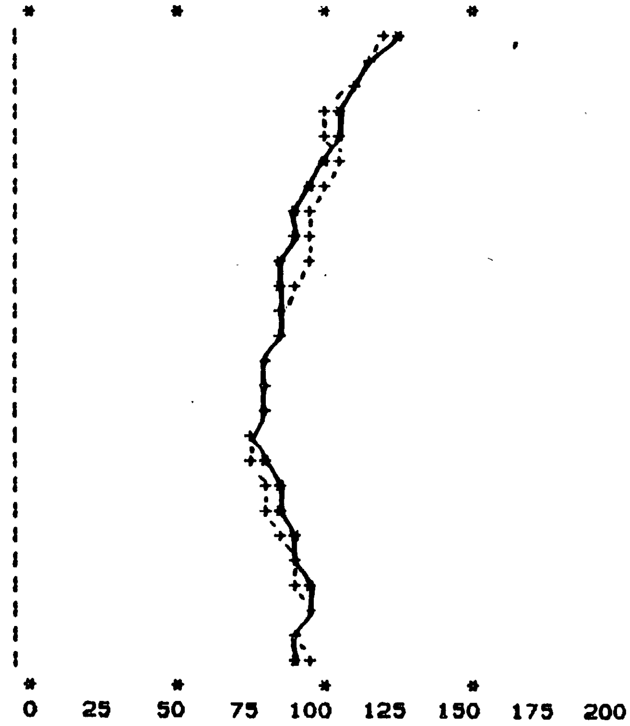


4 CONSTRUCTION (6)

## EMPLOYMENT PER UNIT OF OUTPUT

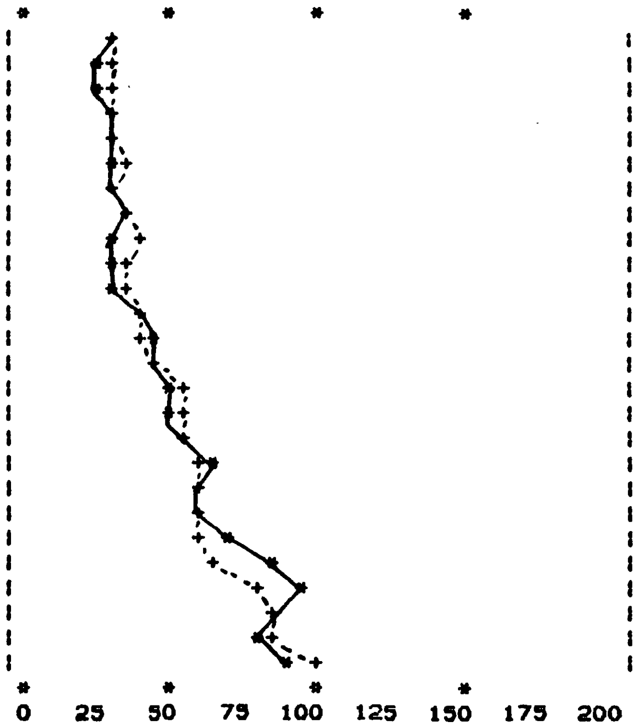
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 5.58 | 5.31 |
| 1953 | 5.23 | 5.15 |
| 1954 | 4.94 | 4.87 |
| 1955 | 4.77 | 4.57 |
| 1956 | 4.65 | 4.46 |
| 1957 | 4.42 | 4.59 |
| 1958 | 4.17 | 4.45 |
| 1959 | 4.01 | 4.13 |
| 1960 | 3.91 | 4.33 |
| 1961 | 3.83 | 4.27 |
| 1962 | 3.86 | 3.95 |
| 1963 | 3.82 | 3.83 |
| 1964 | 3.67 | 3.67 |
| 1965 | 3.59 | 3.58 |
| 1966 | 3.53 | 3.60 |
| 1967 | 3.47 | 3.51 |
| 1968 | 3.40 | 3.32 |
| 1969 | 3.60 | 3.33 |
| 1970 | 3.77 | 3.65 |
| 1971 | 3.81 | 3.61 |
| 1972 | 3.91 | 3.79 |
| 1973 | 4.08 | 3.98 |
| 1974 | 4.22 | 4.00 |
| 1975 | 4.18 | 4.24 |
| 1976 | 3.94 | 3.98 |
| 1977 | 4.06 | 4.24 |

1977 = 100%



## INVESTMENT

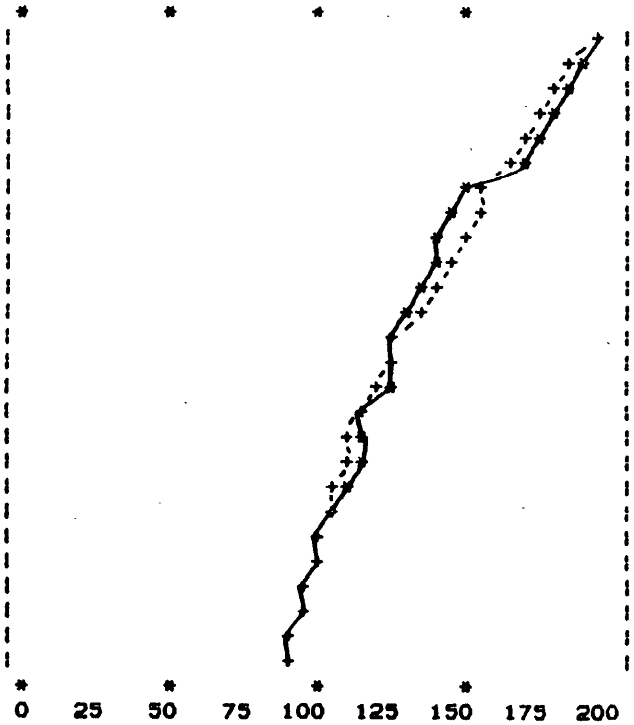
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 3450.5 | 3641.4 |
| 1953 | 3181.7 | 3598.7 |
| 1954 | 3028.2 | 3886.0 |
| 1955 | 3403.3 | 3645.4 |
| 1956 | 3651.3 | 3748.7 |
| 1957 | 3615.5 | 4123.9 |
| 1958 | 3625.0 | 3855.7 |
| 1959 | 4573.5 | 4045.3 |
| 1960 | 3830.5 | 4746.9 |
| 1961 | 3736.6 | 4432.9 |
| 1962 | 4015.3 | 4465.1 |
| 1963 | 4810.8 | 4918.7 |
| 1964 | 5429.1 | 4851.0 |
| 1965 | 6037.8 | 5907.3 |
| 1966 | 6331.5 | 6748.2 |
| 1967 | 6120.4 | 7147.7 |
| 1968 | 7107.5 | 7079.7 |
| 1969 | 8493.0 | 7586.8 |
| 1970 | 8041.3 | 7580.1 |
| 1971 | 7451.8 | 7523.6 |
| 1972 | 8990.4 | 7663.7 |
| 1973 | 11254.5 | 8471.8 |
| 1974 | 12171.9 | 10309.0 |
| 1975 | 10803.4 | 11422.0 |
| 1976 | 10577.8 | 11357.4 |
| 1977 | 11949.1 | 12924.6 |



5 FOOD, TOBACCO (7)

EMPLOYMENT PER UNIT OF OUTPUT

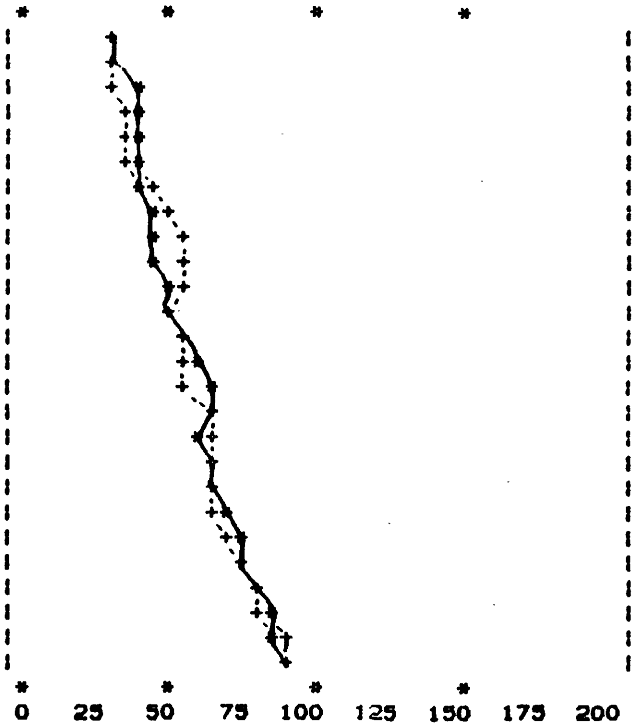
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 1.96 | 1.96 |
| 1953 | 1.90 | 1.88 |
| 1954 | 1.84 | 1.82 |
| 1955 | 1.82 | 1.76 |
| 1956 | 1.74 | 1.68 |
| 1957 | 1.68 | 1.63 |
| 1958 | 1.50 | 1.55 |
| 1959 | 1.46 | 1.54 |
| 1960 | 1.41 | 1.48 |
| 1961 | 1.38 | 1.46 |
| 1962 | 1.33 | 1.38 |
| 1963 | 1.29 | 1.33 |
| 1964 | 1.23 | 1.26 |
| 1965 | 1.24 | 1.23 |
| 1966 | 1.23 | 1.19 |
| 1967 | 1.16 | 1.13 |
| 1968 | 1.14 | 1.10 |
| 1969 | 1.13 | 1.07 |
| 1970 | 1.11 | 1.07 |
| 1971 | 1.06 | 1.04 |
| 1972 | 1.00 | 1.01 |
| 1973 | 0.99 | 1.00 |
| 1974 | 0.95 | 0.96 |
| 1975 | 0.94 | 0.94 |
| 1976 | 0.89 | 0.89 |
| 1977 | 0.90 | 0.90 |



1977 = 100%

INVESTMENT

| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 1079.6 | 1232.8 |
| 1953 | 1152.5 | 1285.7 |
| 1954 | 1586.5 | 1175.1 |
| 1955 | 1649.7 | 1290.0 |
| 1956 | 1710.2 | 1439.4 |
| 1957 | 1715.9 | 1477.8 |
| 1958 | 1683.8 | 1871.0 |
| 1959 | 1767.6 | 2106.5 |
| 1960 | 1773.3 | 2292.2 |
| 1961 | 1824.4 | 2257.4 |
| 1962 | 2052.0 | 2275.5 |
| 1963 | 2086.4 | 2107.4 |
| 1964 | 2306.9 | 2233.5 |
| 1965 | 2389.8 | 2234.3 |
| 1966 | 2675.0 | 2326.2 |
| 1967 | 2698.8 | 2592.6 |
| 1968 | 2552.8 | 2679.0 |
| 1969 | 2629.1 | 2649.7 |
| 1970 | 2746.8 | 2753.1 |
| 1971 | 2859.2 | 2762.1 |
| 1972 | 3011.3 | 2857.1 |
| 1973 | 3023.1 | 3030.8 |
| 1974 | 3300.0 | 3302.6 |
| 1975 | 3537.3 | 3410.2 |
| 1976 | 3612.8 | 3811.4 |
| 1977 | 3816.9 | 3788.5 |

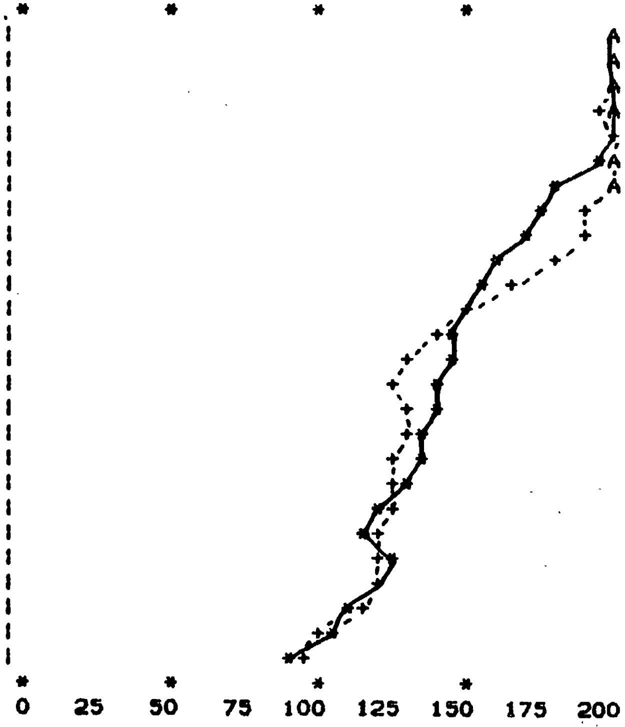


## 6 TEXTILES (8)

### EMPLOYMENT PER UNIT OF OUTPUT

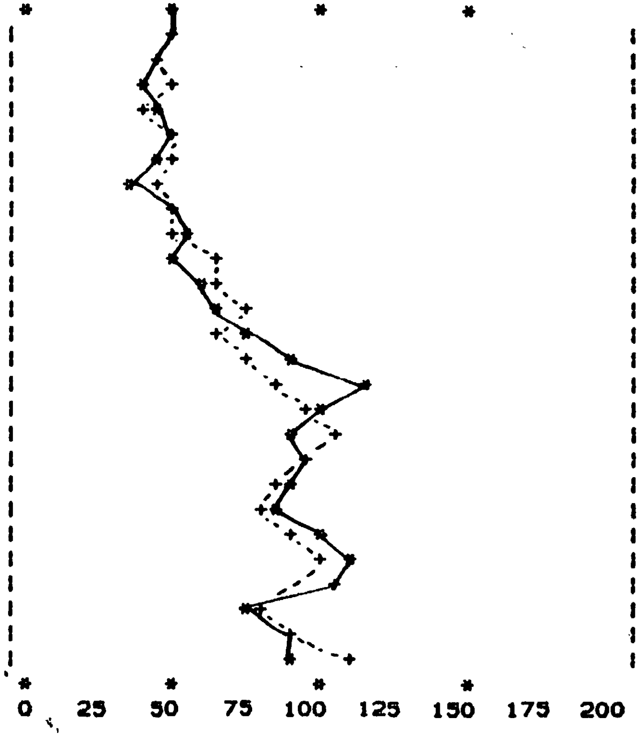
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 4.92 | 4.68 |
| 1953 | 4.70 | 4.51 |
| 1954 | 4.51 | 4.25 |
| 1955 | 4.28 | 3.93 |
| 1956 | 4.14 | 4.01 |
| 1957 | 3.94 | 4.26 |
| 1958 | 3.63 | 4.32 |
| 1959 | 3.48 | 3.82 |
| 1960 | 3.43 | 3.81 |
| 1961 | 3.16 | 3.66 |
| 1962 | 3.06 | 3.31 |
| 1963 | 3.00 | 2.98 |
| 1964 | 2.92 | 2.85 |
| 1965 | 2.89 | 2.64 |
| 1966 | 2.81 | 2.50 |
| 1967 | 2.76 | 2.55 |
| 1968 | 2.75 | 2.55 |
| 1969 | 2.73 | 2.47 |
| 1970 | 2.58 | 2.54 |
| 1971 | 2.43 | 2.55 |
| 1972 | 2.32 | 2.36 |
| 1973 | 2.46 | 2.40 |
| 1974 | 2.41 | 2.40 |
| 1975 | 2.21 | 2.27 |
| 1976 | 2.11 | 1.95 |
| 1977 | 1.81 | 1.90 |

1977 = 100%



### INVESTMENT

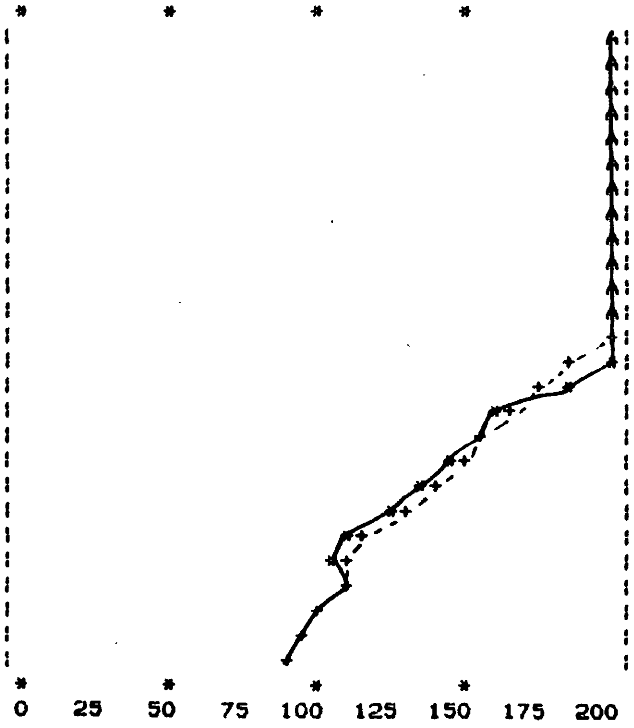
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 539.3 | 515.9 |
| 1953 | 457.8 | 485.5 |
| 1954 | 398.7 | 514.7 |
| 1955 | 464.6 | 381.9 |
| 1956 | 506.0 | 497.0 |
| 1957 | 463.6 | 520.0 |
| 1958 | 378.6 | 456.9 |
| 1959 | 494.8 | 534.7 |
| 1960 | 557.0 | 537.2 |
| 1961 | 530.7 | 665.7 |
| 1962 | 634.6 | 689.5 |
| 1963 | 658.1 | 763.2 |
| 1964 | 796.7 | 693.6 |
| 1965 | 964.6 | 774.9 |
| 1966 | 1211.4 | 917.8 |
| 1967 | 1057.3 | 1029.9 |
| 1968 | 925.8 | 1093.1 |
| 1969 | 1003.9 | 988.7 |
| 1970 | 940.5 | 901.9 |
| 1971 | 890.3 | 816.5 |
| 1972 | 1054.8 | 959.6 |
| 1973 | 1152.7 | 1081.9 |
| 1974 | 1091.9 | 1105.1 |
| 1975 | 812.7 | 849.1 |
| 1976 | 944.5 | 956.0 |
| 1977 | 967.1 | 1168.0 |



7 KNITTING, HOSIERY (9)

## EMPLOYMENT PER UNIT OF OUTPUT

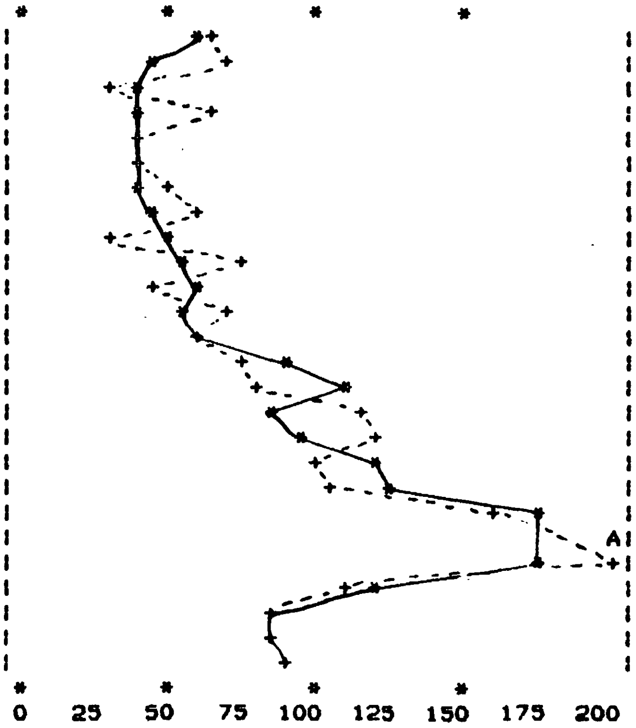
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 11.88 | 11.68 |
| 1953 | 10.78 | 10.91 |
| 1954 | 10.60 | 10.52 |
| 1955 | 9.73 | 9.58 |
| 1956 | 9.31 | 9.42 |
| 1957 | 8.61 | 9.00 |
| 1958 | 7.84 | 8.54 |
| 1959 | 8.06 | 8.00 |
| 1960 | 7.73 | 7.65 |
| 1961 | 6.94 | 6.81 |
| 1962 | 6.87 | 6.38 |
| 1963 | 5.97 | 5.83 |
| 1964 | 5.65 | 5.55 |
| 1965 | 5.54 | 5.15 |
| 1966 | 5.17 | 4.91 |
| 1967 | 4.46 | 4.53 |
| 1968 | 4.35 | 4.25 |
| 1969 | 4.00 | 4.11 |
| 1970 | 3.73 | 3.93 |
| 1971 | 3.47 | 3.56 |
| 1972 | 2.99 | 3.16 |
| 1973 | 2.83 | 3.06 |
| 1974 | 3.04 | 3.03 |
| 1975 | 2.70 | 2.81 |
| 1976 | 2.68 | 2.63 |
| 1977 | 2.51 | 2.45 |



1977 = 100%

## INVESTMENT

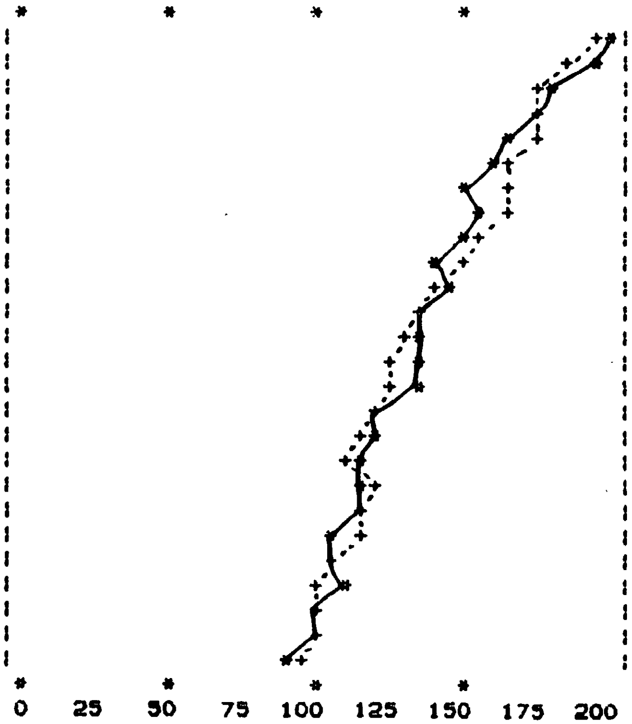
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 67.1 | 74.1 |
| 1953 | 54.8 | 79.8 |
| 1954 | 47.7 | 32.5 |
| 1955 | 42.8 | 78.6 |
| 1956 | 45.6 | 47.2 |
| 1957 | 48.0 | 43.3 |
| 1958 | 45.6 | 56.1 |
| 1959 | 54.0 | 67.4 |
| 1960 | 60.9 | 32.8 |
| 1961 | 65.1 | 87.4 |
| 1962 | 67.2 | 53.2 |
| 1963 | 61.8 | 80.3 |
| 1964 | 67.0 | 67.1 |
| 1965 | 104.8 | 87.2 |
| 1966 | 128.6 | 95.9 |
| 1967 | 102.7 | 139.7 |
| 1968 | 110.7 | 144.8 |
| 1969 | 144.3 | 116.3 |
| 1970 | 146.6 | 126.1 |
| 1971 | 208.5 | 190.3 |
| 1972 | 347.1 | 302.7 |
| 1973 | 209.1 | 239.6 |
| 1974 | 143.0 | 132.8 |
| 1975 | 102.8 | 99.5 |
| 1976 | 98.5 | 101.2 |
| 1977 | 108.3 | 107.0 |



## 8 APPAREL AND HOUSEHOLD TEXTILES (10)

### EMPLOYMENT PER UNIT OF OUTPUT

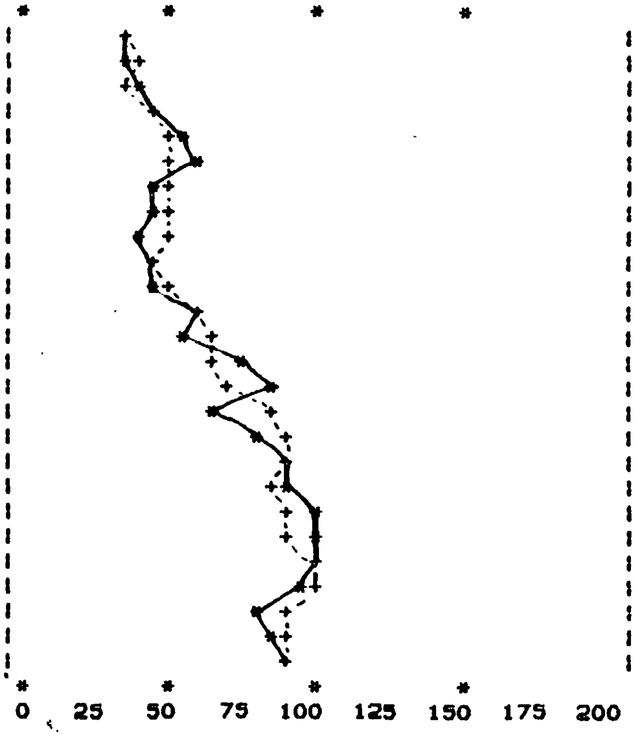
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 7.11 | 6.83 |
| 1953 | 6.96 | 6.54 |
| 1954 | 6.29 | 6.19 |
| 1955 | 6.15 | 6.13 |
| 1956 | 5.84 | 6.17 |
| 1957 | 5.67 | 5.87 |
| 1958 | 5.29 | 5.88 |
| 1959 | 5.50 | 5.74 |
| 1960 | 5.21 | 5.53 |
| 1961 | 5.02 | 5.28 |
| 1962 | 5.07 | 5.01 |
| 1963 | 4.83 | 4.82 |
| 1964 | 4.77 | 4.57 |
| 1965 | 4.72 | 4.37 |
| 1966 | 4.71 | 4.31 |
| 1967 | 4.22 | 4.14 |
| 1968 | 4.16 | 4.12 |
| 1969 | 4.10 | 3.90 |
| 1970 | 4.06 | 4.13 |
| 1971 | 3.94 | 3.96 |
| 1972 | 3.67 | 3.94 |
| 1973 | 3.70 | 3.73 |
| 1974 | 3.80 | 3.54 |
| 1975 | 3.49 | 3.50 |
| 1976 | 3.57 | 3.50 |
| 1977 | 3.18 | 3.26 |



1977 = 100%

### INVESTMENT

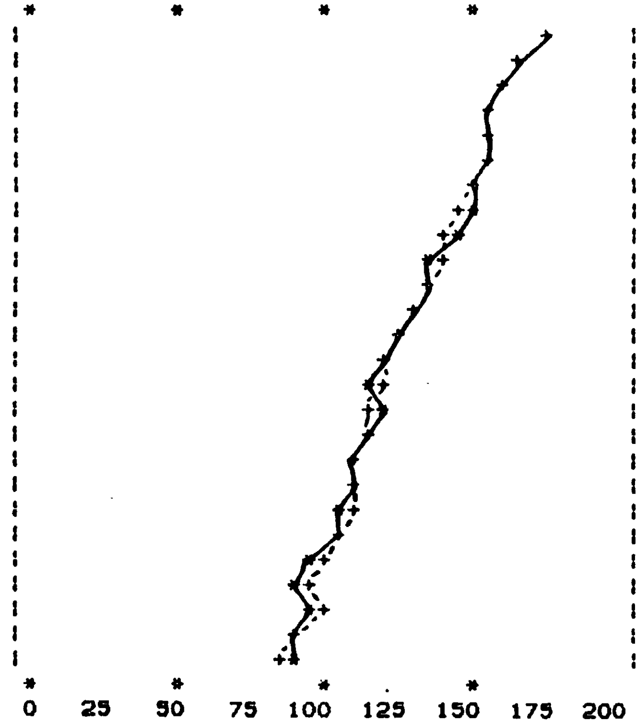
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 210.0 | 205.3 |
| 1953 | 234.3 | 246.2 |
| 1954 | 256.4 | 208.5 |
| 1955 | 301.8 | 287.6 |
| 1956 | 352.3 | 320.5 |
| 1957 | 390.6 | 335.8 |
| 1958 | 280.1 | 308.7 |
| 1959 | 287.0 | 338.7 |
| 1960 | 267.8 | 306.2 |
| 1961 | 277.3 | 289.2 |
| 1962 | 305.7 | 338.8 |
| 1963 | 390.3 | 374.1 |
| 1964 | 360.9 | 413.8 |
| 1965 | 505.7 | 417.6 |
| 1966 | 568.3 | 463.4 |
| 1967 | 441.7 | 576.3 |
| 1968 | 524.6 | 595.2 |
| 1969 | 601.1 | 591.6 |
| 1970 | 600.9 | 555.6 |
| 1971 | 666.3 | 580.4 |
| 1972 | 665.0 | 603.5 |
| 1973 | 661.1 | 659.7 |
| 1974 | 631.0 | 650.3 |
| 1975 | 513.7 | 586.8 |
| 1976 | 569.4 | 607.0 |
| 1977 | 604.4 | 607.2 |



9 PAPER (11)

EMPLOYMENT PER UNIT OF OUTPUT

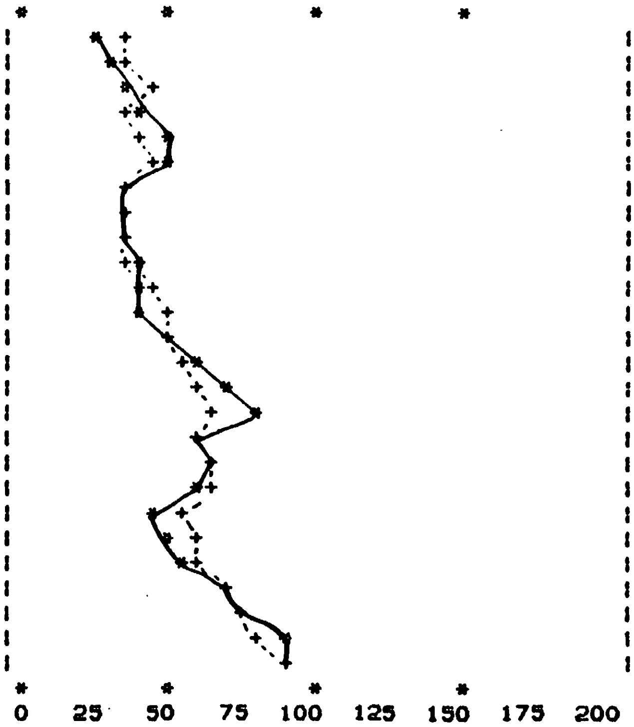
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 2.71 | 2.68 |
| 1953 | 2.53 | 2.55 |
| 1954 | 2.44 | 2.46 |
| 1955 | 2.33 | 2.35 |
| 1956 | 2.36 | 2.39 |
| 1957 | 2.34 | 2.33 |
| 1958 | 2.27 | 2.28 |
| 1959 | 2.27 | 2.19 |
| 1960 | 2.18 | 2.16 |
| 1961 | 2.08 | 2.12 |
| 1962 | 2.07 | 2.07 |
| 1963 | 1.97 | 2.00 |
| 1964 | 1.90 | 1.91 |
| 1965 | 1.83 | 1.84 |
| 1966 | 1.78 | 1.79 |
| 1967 | 1.82 | 1.77 |
| 1968 | 1.73 | 1.71 |
| 1969 | 1.69 | 1.67 |
| 1970 | 1.70 | 1.66 |
| 1971 | 1.62 | 1.63 |
| 1972 | 1.55 | 1.56 |
| 1973 | 1.45 | 1.50 |
| 1974 | 1.38 | 1.45 |
| 1975 | 1.45 | 1.48 |
| 1976 | 1.39 | 1.35 |
| 1977 | 1.38 | 1.32 |



1977 = 100%

INVESTMENT

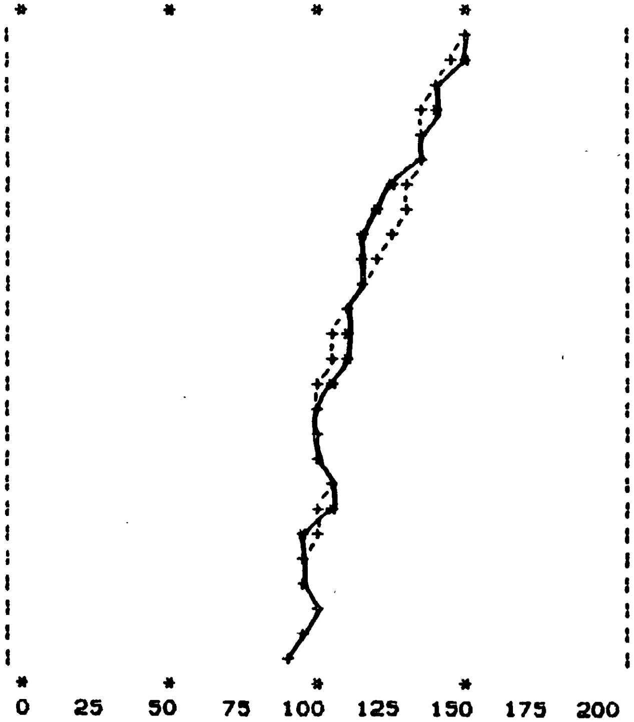
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 773.3 | 963.6 |
| 1953 | 831.6 | 1006.7 |
| 1954 | 983.5 | 1301.6 |
| 1955 | 1114.9 | 1015.4 |
| 1956 | 1469.4 | 1188.4 |
| 1957 | 1541.1 | 1290.1 |
| 1958 | 1022.5 | 1019.0 |
| 1959 | 1054.5 | 1050.2 |
| 1960 | 1070.3 | 969.5 |
| 1961 | 1124.7 | 1106.3 |
| 1962 | 1246.0 | 1311.9 |
| 1963 | 1200.9 | 1483.6 |
| 1964 | 1513.7 | 1517.8 |
| 1965 | 1904.9 | 1594.1 |
| 1966 | 2157.5 | 1771.4 |
| 1967 | 2411.2 | 1965.0 |
| 1968 | 1765.4 | 1818.2 |
| 1969 | 1941.1 | 2022.3 |
| 1970 | 1797.3 | 2020.8 |
| 1971 | 1402.2 | 1638.1 |
| 1972 | 1477.2 | 1759.8 |
| 1973 | 1698.5 | 1847.8 |
| 1974 | 2065.0 | 2162.2 |
| 1975 | 2245.0 | 2357.8 |
| 1976 | 2703.2 | 2410.1 |
| 1977 | 2823.7 | 2747.1 |



10 PRINTING (12)

## EMPLOYMENT PER UNIT OF OUTPUT

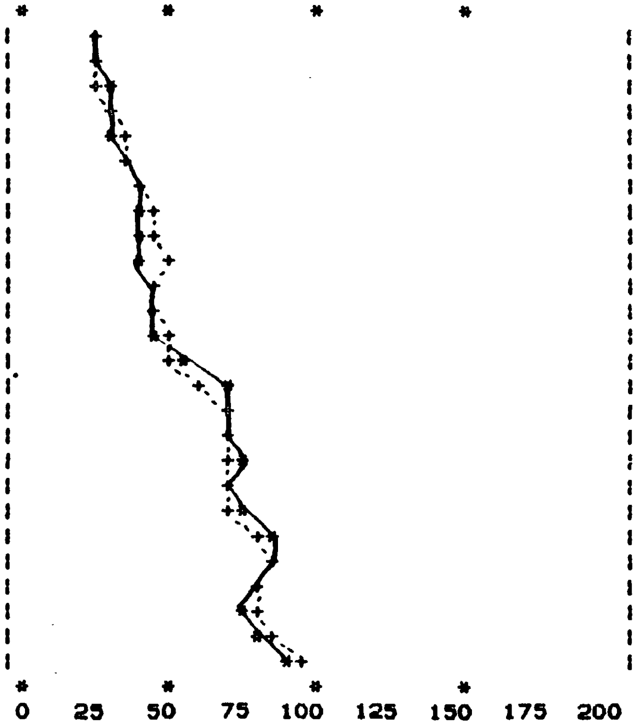
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 3.86 | 3.86 |
| 1953 | 3.89 | 3.73 |
| 1954 | 3.70 | 3.61 |
| 1955 | 3.63 | 3.52 |
| 1956 | 3.54 | 3.49 |
| 1957 | 3.53 | 3.56 |
| 1958 | 3.19 | 3.41 |
| 1959 | 3.11 | 3.41 |
| 1960 | 3.03 | 3.26 |
| 1961 | 3.00 | 3.15 |
| 1962 | 2.94 | 2.97 |
| 1963 | 2.92 | 2.87 |
| 1964 | 2.82 | 2.73 |
| 1965 | 2.79 | 2.67 |
| 1966 | 2.73 | 2.59 |
| 1967 | 2.66 | 2.59 |
| 1968 | 2.64 | 2.59 |
| 1969 | 2.63 | 2.60 |
| 1970 | 2.78 | 2.73 |
| 1971 | 2.70 | 2.65 |
| 1972 | 2.49 | 2.55 |
| 1973 | 2.45 | 2.49 |
| 1974 | 2.46 | 2.51 |
| 1975 | 2.58 | 2.55 |
| 1976 | 2.47 | 2.44 |
| 1977 | 2.36 | 2.36 |



1977 = 100%

## INVESTMENT

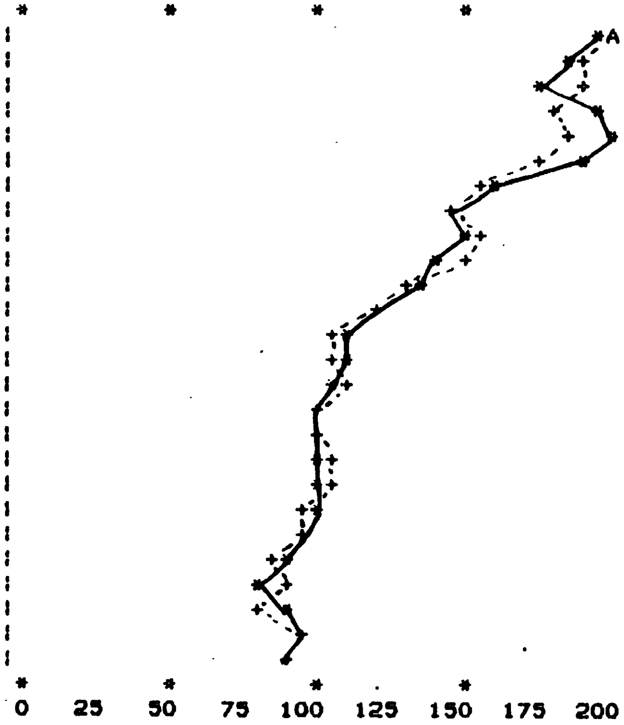
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 381.4 | 367.8 |
| 1953 | 390.9 | 350.8 |
| 1954 | 439.0 | 398.4 |
| 1955 | 471.6 | 448.8 |
| 1956 | 487.0 | 501.5 |
| 1957 | 530.2 | 504.6 |
| 1958 | 599.9 | 627.4 |
| 1959 | 574.4 | 654.9 |
| 1960 | 637.8 | 729.5 |
| 1961 | 626.4 | 752.3 |
| 1962 | 666.5 | 713.3 |
| 1963 | 728.1 | 650.4 |
| 1964 | 702.4 | 733.4 |
| 1965 | 831.8 | 761.7 |
| 1966 | 1064.4 | 931.9 |
| 1967 | 1109.9 | 1070.1 |
| 1968 | 1064.5 | 1119.5 |
| 1969 | 1141.4 | 1102.3 |
| 1970 | 1116.8 | 1070.4 |
| 1971 | 1145.7 | 1068.7 |
| 1972 | 1335.5 | 1261.4 |
| 1973 | 1358.5 | 1355.0 |
| 1974 | 1263.3 | 1298.2 |
| 1975 | 1201.2 | 1254.1 |
| 1976 | 1273.7 | 1317.4 |
| 1977 | 1443.6 | 1542.0 |



11 AGRICULTURE FERTILIZERS (13)

## EMPLOYMENT PER UNIT OF OUTPUT

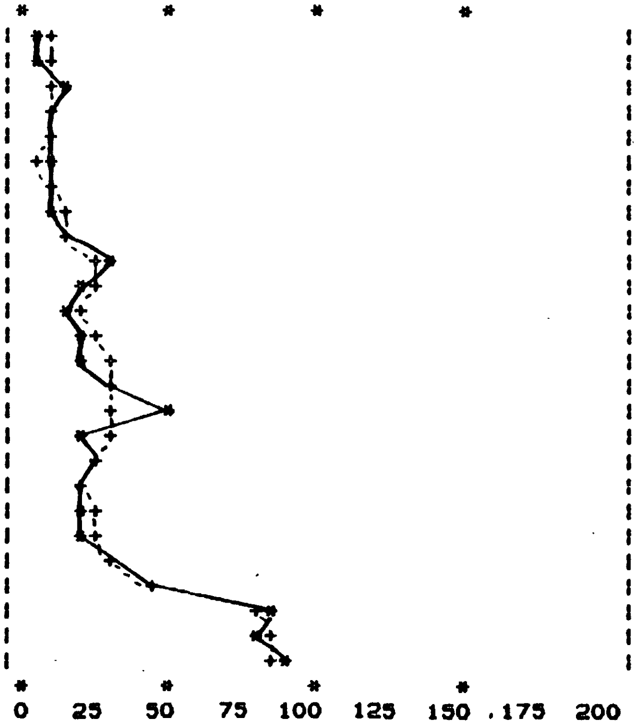
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 1.29 | 1.35 |
| 1953 | 1.24 | 1.26 |
| 1954 | 1.16 | 1.25 |
| 1955 | 1.28 | 1.19 |
| 1956 | 1.31 | 1.24 |
| 1957 | 1.26 | 1.15 |
| 1958 | 1.05 | 1.04 |
| 1959 | 0.95 | 0.95 |
| 1960 | 0.98 | 1.01 |
| 1961 | 0.92 | 0.98 |
| 1962 | 0.87 | 0.86 |
| 1963 | 0.80 | 0.79 |
| 1964 | 0.71 | 0.70 |
| 1965 | 0.71 | 0.70 |
| 1966 | 0.68 | 0.72 |
| 1967 | 0.66 | 0.67 |
| 1968 | 0.66 | 0.65 |
| 1969 | 0.65 | 0.68 |
| 1970 | 0.66 | 0.70 |
| 1971 | 0.66 | 0.63 |
| 1972 | 0.61 | 0.61 |
| 1973 | 0.58 | 0.56 |
| 1974 | 0.51 | 0.58 |
| 1975 | 0.58 | 0.53 |
| 1976 | 0.62 | 0.63 |
| 1977 | 0.60 | 0.60 |



1977 = 100%

## INVESTMENT

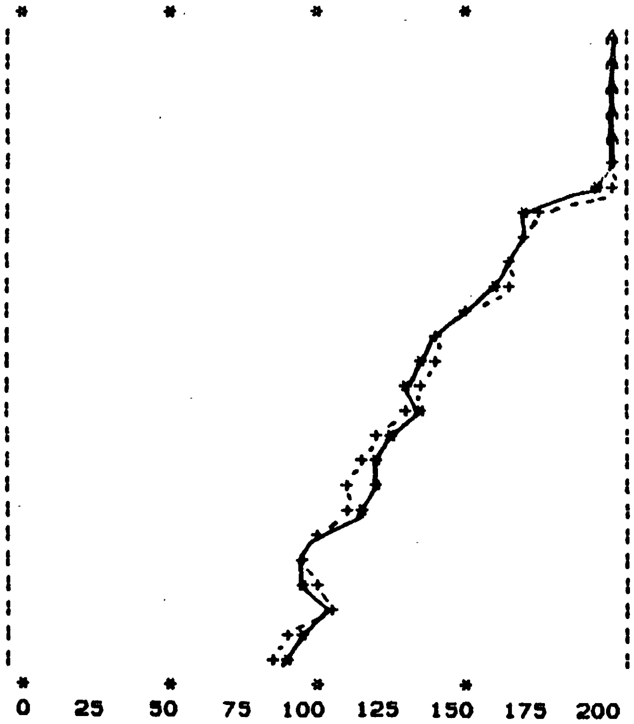
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 48.6 | 68.8 |
| 1953 | 52.4 | 64.2 |
| 1954 | 119.3 | 89.9 |
| 1955 | 111.4 | 99.4 |
| 1956 | 103.8 | 77.7 |
| 1957 | 105.0 | 50.5 |
| 1958 | 105.6 | 60.2 |
| 1959 | 102.1 | 112.6 |
| 1960 | 138.8 | 161.2 |
| 1961 | 288.2 | 225.7 |
| 1962 | 183.6 | 230.3 |
| 1963 | 149.2 | 206.0 |
| 1964 | 178.5 | 279.7 |
| 1965 | 200.4 | 320.0 |
| 1966 | 312.0 | 285.3 |
| 1967 | 505.4 | 280.1 |
| 1968 | 208.5 | 293.5 |
| 1969 | 231.5 | 227.5 |
| 1970 | 204.2 | 201.0 |
| 1971 | 181.1 | 241.8 |
| 1972 | 180.1 | 231.3 |
| 1973 | 316.9 | 300.2 |
| 1974 | 490.7 | 474.5 |
| 1975 | 914.9 | 866.5 |
| 1976 | 887.0 | 936.6 |
| 1977 | 995.4 | 929.9 |



12 OTHER CHEMICALS (14)

## EMPLOYMENT PER UNIT OF OUTPUT

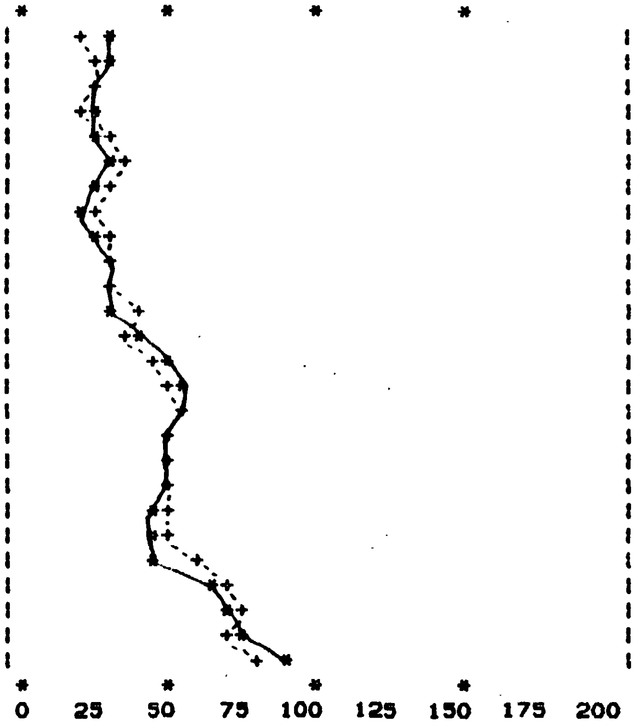
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 2.79 | 2.79 |
| 1953 | 2.74 | 2.68 |
| 1954 | 2.53 | 2.45 |
| 1955 | 2.25 | 2.24 |
| 1956 | 2.16 | 2.23 |
| 1957 | 2.16 | 2.18 |
| 1958 | 2.09 | 2.15 |
| 1959 | 1.84 | 1.89 |
| 1960 | 1.85 | 1.86 |
| 1961 | 1.80 | 1.78 |
| 1962 | 1.71 | 1.76 |
| 1963 | 1.62 | 1.60 |
| 1964 | 1.52 | 1.53 |
| 1965 | 1.43 | 1.50 |
| 1966 | 1.40 | 1.43 |
| 1967 | 1.45 | 1.41 |
| 1968 | 1.36 | 1.31 |
| 1969 | 1.31 | 1.25 |
| 1970 | 1.28 | 1.19 |
| 1971 | 1.21 | 1.19 |
| 1972 | 1.07 | 1.09 |
| 1973 | 1.00 | 1.03 |
| 1974 | 0.99 | 1.06 |
| 1975 | 1.11 | 1.12 |
| 1976 | 0.99 | 0.98 |
| 1977 | 0.97 | 0.93 |



1977 = 100%

## INVESTMENT

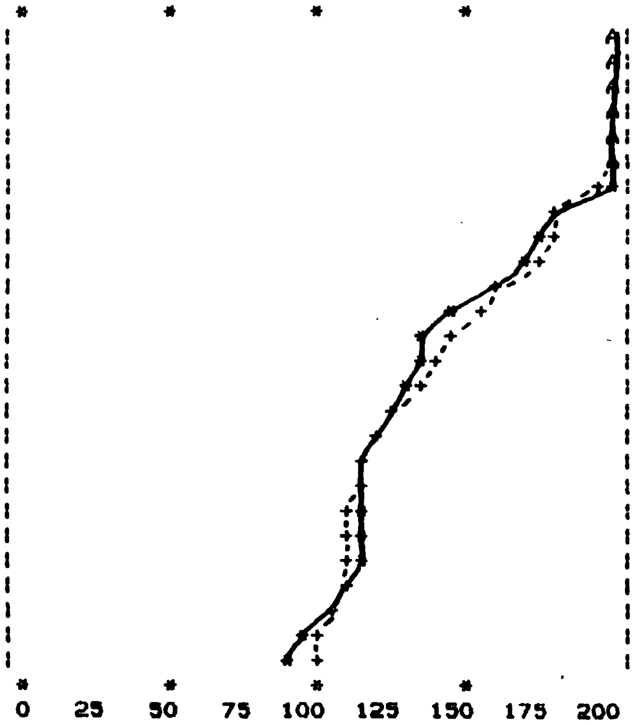
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 2173.2 | 1462.2 |
| 1953 | 2016.4 | 1641.2 |
| 1954 | 1853.7 | 1704.0 |
| 1955 | 1748.6 | 1462.0 |
| 1956 | 1844.9 | 1984.8 |
| 1957 | 1968.7 | 2281.1 |
| 1958 | 1829.2 | 2074.2 |
| 1959 | 1396.9 | 1812.2 |
| 1960 | 1860.2 | 2029.2 |
| 1961 | 2118.5 | 1943.8 |
| 1962 | 2070.7 | 2158.2 |
| 1963 | 2252.7 | 2655.3 |
| 1964 | 2713.9 | 2403.3 |
| 1965 | 3569.9 | 3023.3 |
| 1966 | 3930.0 | 3580.9 |
| 1967 | 3854.6 | 3845.0 |
| 1968 | 3492.4 | 3446.8 |
| 1969 | 3442.2 | 3666.6 |
| 1970 | 3680.5 | 3689.0 |
| 1971 | 3326.0 | 3406.2 |
| 1972 | 3093.4 | 3504.1 |
| 1973 | 3372.9 | 4142.3 |
| 1974 | 4625.6 | 5047.0 |
| 1975 | 5013.2 | 5321.9 |
| 1976 | 5438.1 | 5167.4 |
| 1977 | 6693.0 | 5927.5 |



## 13 PETROLEUM REFINING & FUEL OIL (15,16

### EMPLOYMENT PER UNIT OF OUTPUT

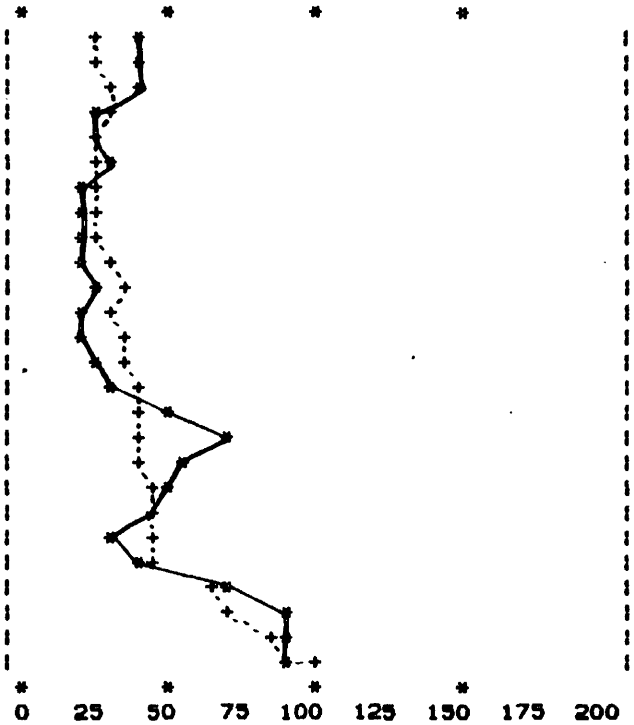
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 0.49 | 0.49 |
| 1953 | 0.49 | 0.49 |
| 1954 | 0.45 | 0.45 |
| 1955 | 0.43 | 0.42 |
| 1956 | 0.41 | 0.41 |
| 1957 | 0.41 | 0.39 |
| 1958 | 0.37 | 0.36 |
| 1959 | 0.33 | 0.33 |
| 1960 | 0.33 | 0.34 |
| 1961 | 0.31 | 0.33 |
| 1962 | 0.29 | 0.30 |
| 1963 | 0.27 | 0.28 |
| 1964 | 0.25 | 0.26 |
| 1965 | 0.25 | 0.25 |
| 1966 | 0.24 | 0.24 |
| 1967 | 0.23 | 0.23 |
| 1968 | 0.22 | 0.22 |
| 1969 | 0.21 | 0.21 |
| 1970 | 0.21 | 0.21 |
| 1971 | 0.22 | 0.20 |
| 1972 | 0.21 | 0.20 |
| 1973 | 0.21 | 0.20 |
| 1974 | 0.20 | 0.20 |
| 1975 | 0.19 | 0.19 |
| 1976 | 0.18 | 0.18 |
| 1977 | 0.17 | 0.18 |



1977 = 100%

### INVESTMENT

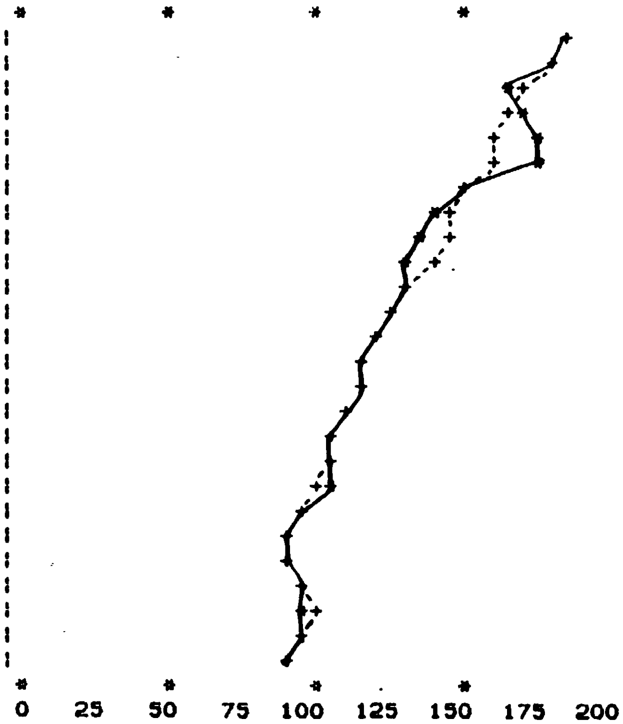
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 666.8 | 419.4 |
| 1953 | 698.0 | 408.4 |
| 1954 | 613.8 | 499.6 |
| 1955 | 378.6 | 441.1 |
| 1956 | 351.4 | 415.6 |
| 1957 | 514.4 | 392.5 |
| 1958 | 336.9 | 430.8 |
| 1959 | 306.5 | 434.7 |
| 1960 | 267.4 | 385.4 |
| 1961 | 264.2 | 500.0 |
| 1962 | 377.8 | 524.3 |
| 1963 | 271.9 | 511.6 |
| 1964 | 303.1 | 570.4 |
| 1965 | 372.1 | 598.4 |
| 1966 | 461.3 | 623.8 |
| 1967 | 847.8 | 620.3 |
| 1968 | 1177.3 | 633.0 |
| 1969 | 879.5 | 656.9 |
| 1970 | 813.7 | 704.6 |
| 1971 | 716.5 | 737.9 |
| 1972 | 517.9 | 780.6 |
| 1973 | 659.9 | 783.0 |
| 1974 | 1177.8 | 1100.0 |
| 1975 | 1484.3 | 1200.4 |
| 1976 | 1557.6 | 1459.8 |
| 1977 | 1551.6 | 1735.7 |



# 14 RUBBER AND PLASTIC PRODUCTS (17,18)

## EMPLOYMENT PER UNIT OF OUTPUT

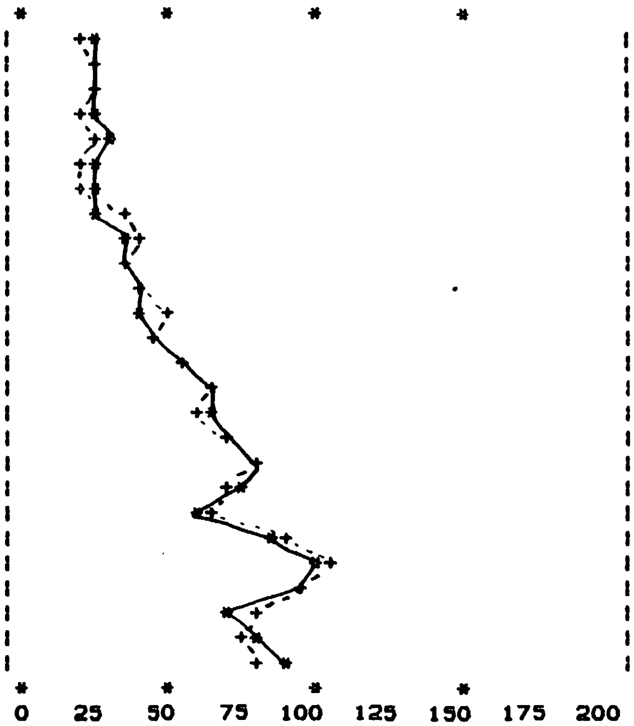
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 3.96 | 3.99 |
| 1953 | 3.82 | 3.89 |
| 1954 | 3.59 | 3.66 |
| 1955 | 3.66 | 3.57 |
| 1956 | 3.70 | 3.46 |
| 1957 | 3.73 | 3.46 |
| 1958 | 3.16 | 3.24 |
| 1959 | 2.96 | 3.08 |
| 1960 | 2.88 | 3.06 |
| 1961 | 2.76 | 2.96 |
| 1962 | 2.76 | 2.79 |
| 1963 | 2.66 | 2.64 |
| 1964 | 2.54 | 2.54 |
| 1965 | 2.49 | 2.50 |
| 1966 | 2.48 | 2.42 |
| 1967 | 2.36 | 2.32 |
| 1968 | 2.28 | 2.23 |
| 1969 | 2.22 | 2.18 |
| 1970 | 2.20 | 2.16 |
| 1971 | 2.03 | 2.04 |
| 1972 | 1.93 | 1.93 |
| 1973 | 1.87 | 1.88 |
| 1974 | 1.96 | 2.01 |
| 1975 | 2.06 | 2.09 |
| 1976 | 2.00 | 2.01 |
| 1977 | 1.94 | 1.87 |



1977 = 100%

## INVESTMENT

| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 363.4 | 285.4 |
| 1953 | 357.3 | 342.3 |
| 1954 | 364.0 | 373.2 |
| 1955 | 356.7 | 292.6 |
| 1956 | 389.8 | 334.7 |
| 1957 | 346.7 | 287.4 |
| 1958 | 323.7 | 294.7 |
| 1959 | 374.4 | 513.3 |
| 1960 | 494.0 | 548.9 |
| 1961 | 472.3 | 507.7 |
| 1962 | 594.4 | 607.0 |
| 1963 | 565.8 | 699.3 |
| 1964 | 631.9 | 629.0 |
| 1965 | 825.4 | 798.4 |
| 1966 | 924.2 | 949.0 |
| 1967 | 986.4 | 898.9 |
| 1968 | 1037.8 | 1002.4 |
| 1969 | 1185.8 | 1156.6 |
| 1970 | 1070.7 | 1004.7 |
| 1971 | 908.6 | 955.8 |
| 1972 | 1245.1 | 1343.6 |
| 1973 | 1517.8 | 1600.5 |
| 1974 | 1446.0 | 1396.8 |
| 1975 | 1023.8 | 1194.4 |
| 1976 | 1160.3 | 1103.4 |
| 1977 | 1354.9 | 1201.6 |

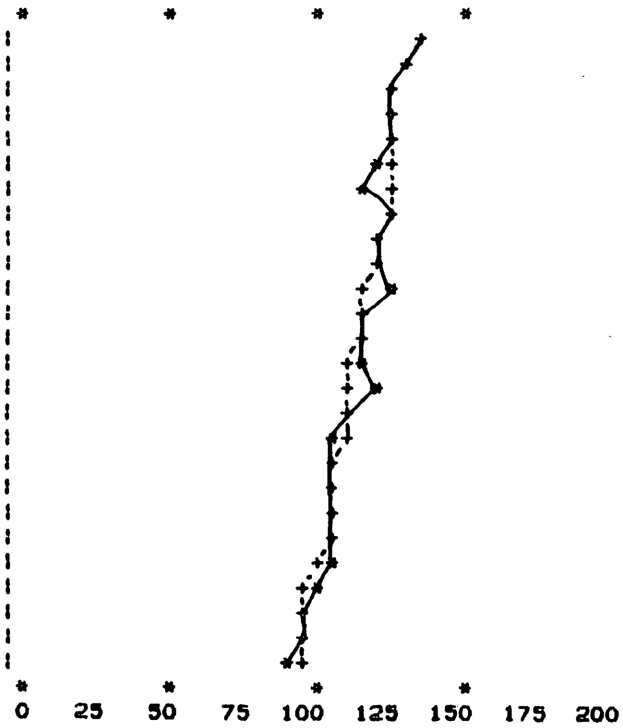


## 15 FOOTWEAR AND LEATHER (19)

### EMPLOYMENT PER UNIT OF OUTPUT

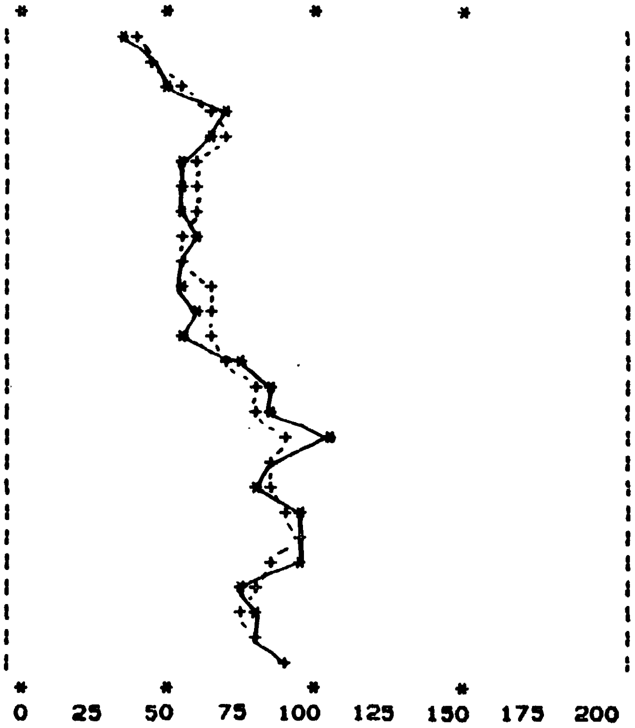
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 5.20 | 5.18 |
| 1953 | 5.10 | 5.09 |
| 1954 | 4.93 | 4.93 |
| 1955 | 4.91 | 4.87 |
| 1956 | 4.88 | 4.85 |
| 1957 | 4.68 | 4.83 |
| 1958 | 4.54 | 4.78 |
| 1959 | 4.76 | 4.79 |
| 1960 | 4.73 | 4.67 |
| 1961 | 4.70 | 4.63 |
| 1962 | 4.79 | 4.53 |
| 1963 | 4.47 | 4.50 |
| 1964 | 4.35 | 4.45 |
| 1965 | 4.35 | 4.33 |
| 1966 | 4.56 | 4.25 |
| 1967 | 4.23 | 4.25 |
| 1968 | 4.12 | 4.25 |
| 1969 | 4.10 | 4.12 |
| 1970 | 4.09 | 4.09 |
| 1971 | 4.08 | 4.08 |
| 1972 | 4.01 | 4.05 |
| 1973 | 3.95 | 3.92 |
| 1974 | 3.78 | 3.73 |
| 1975 | 3.60 | 3.64 |
| 1976 | 3.71 | 3.68 |
| 1977 | 3.51 | 3.61 |

1977 = 100%



### INVESTMENT

| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 32.8 | 37.2 |
| 1953 | 41.0 | 41.4 |
| 1954 | 46.6 | 51.2 |
| 1955 | 67.5 | 60.7 |
| 1956 | 61.4 | 65.3 |
| 1957 | 52.6 | 56.3 |
| 1958 | 49.5 | 55.5 |
| 1959 | 53.5 | 57.6 |
| 1960 | 55.9 | 50.8 |
| 1961 | 50.3 | 53.5 |
| 1962 | 54.1 | 62.7 |
| 1963 | 55.2 | 60.0 |
| 1964 | 54.2 | 62.0 |
| 1965 | 71.7 | 68.5 |
| 1966 | 81.0 | 75.1 |
| 1967 | 79.7 | 77.8 |
| 1968 | 98.8 | 85.8 |
| 1969 | 81.2 | 82.0 |
| 1970 | 79.0 | 79.7 |
| 1971 | 89.0 | 84.7 |
| 1972 | 90.8 | 90.5 |
| 1973 | 90.0 | 79.3 |
| 1974 | 73.7 | 77.4 |
| 1975 | 76.9 | 73.1 |
| 1976 | 77.8 | 78.9 |
| 1977 | 87.9 | 85.2 |

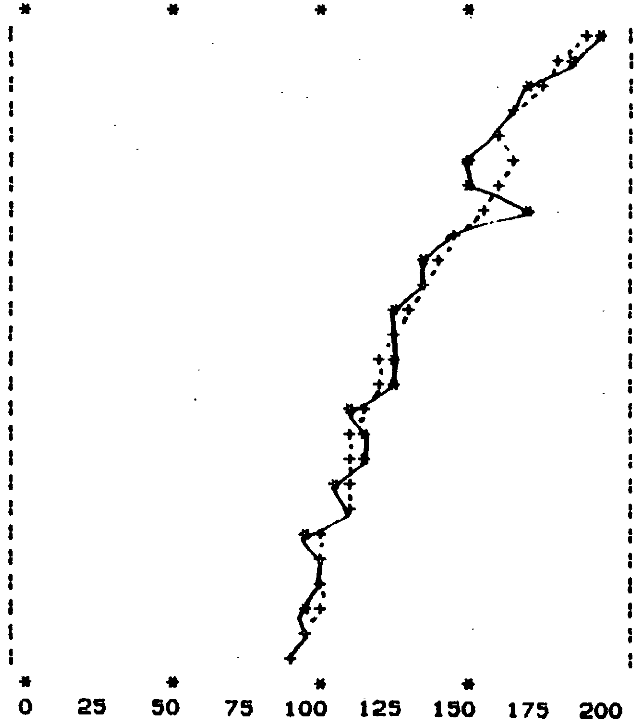


16 LUMBER (20)

## EMPLOYMENT PER UNIT OF OUTPUT

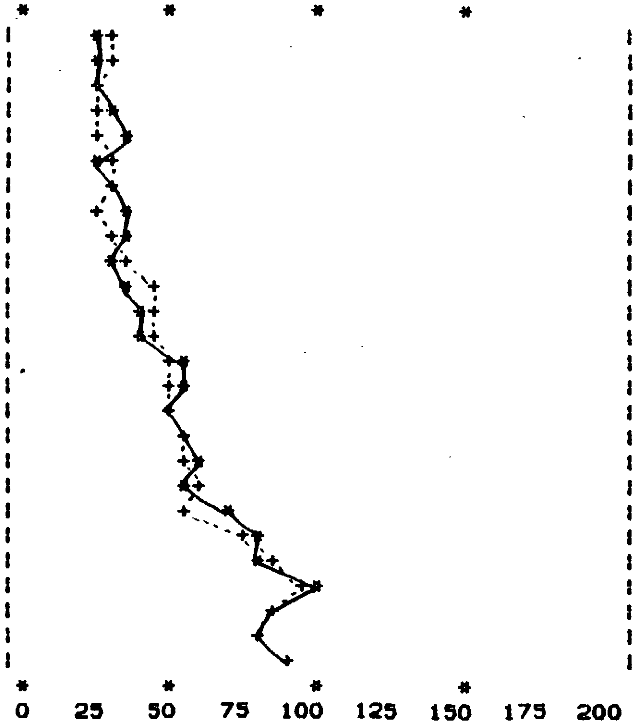
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 3.62 | 3.50 |
| 1953 | 3.43 | 3.36 |
| 1954 | 3.18 | 3.22 |
| 1955 | 3.02 | 3.07 |
| 1956 | 3.01 | 3.00 |
| 1957 | 2.80 | 3.03 |
| 1958 | 2.82 | 3.00 |
| 1959 | 3.15 | 2.84 |
| 1960 | 2.64 | 2.68 |
| 1961 | 2.49 | 2.58 |
| 1962 | 2.50 | 2.50 |
| 1963 | 2.33 | 2.37 |
| 1964 | 2.28 | 2.30 |
| 1965 | 2.33 | 2.25 |
| 1966 | 2.30 | 2.19 |
| 1967 | 2.06 | 2.09 |
| 1968 | 2.10 | 2.04 |
| 1969 | 2.14 | 2.04 |
| 1970 | 1.96 | 2.06 |
| 1971 | 2.00 | 2.00 |
| 1972 | 1.79 | 1.88 |
| 1973 | 1.88 | 1.85 |
| 1974 | 1.82 | 1.83 |
| 1975 | 1.75 | 1.80 |
| 1976 | 1.75 | 1.70 |
| 1977 | 1.68 | 1.63 |

1977 = 100%



## INVESTMENT

| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 353.8 | 423.7 |
| 1953 | 342.1 | 396.7 |
| 1954 | 297.5 | 316.4 |
| 1955 | 390.8 | 320.0 |
| 1956 | 467.0 | 346.8 |
| 1957 | 342.0 | 401.7 |
| 1958 | 405.7 | 396.9 |
| 1959 | 467.9 | 360.2 |
| 1960 | 506.6 | 406.1 |
| 1961 | 363.4 | 467.0 |
| 1962 | 446.4 | 590.0 |
| 1963 | 549.1 | 621.9 |
| 1964 | 556.9 | 648.2 |
| 1965 | 758.2 | 686.9 |
| 1966 | 764.7 | 715.9 |
| 1967 | 662.7 | 723.2 |
| 1968 | 751.9 | 739.9 |
| 1969 | 867.0 | 783.5 |
| 1970 | 753.8 | 811.6 |
| 1971 | 949.5 | 797.4 |
| 1972 | 1091.3 | 1080.9 |
| 1973 | 1124.1 | 1168.2 |
| 1974 | 1395.3 | 1375.9 |
| 1975 | 1223.2 | 1225.1 |
| 1976 | 1110.5 | 1156.1 |
| 1977 | 1290.2 | 1271.6 |



```
17 FUNITURE (21)

              EMPLOYMENT PER UNIT OF OUTPUT

YEAR ACT(*) PRED(+)
---- ------ ------
1952   5.12   4.97
1953   4.95   4.78
1954   4.49   4.49
1955   4.42   4.51
1956   4.44   4.43
1957   4.38   4.59
1958   4.28   4.53
1959   4.57   4.59
1960   4.30   4.47
1961   4.25   4.30
1962   4.17   4.28
1963   3.95   3.96
1964   3.91   3.77
1965   3.90   3.72
1966   3.81   3.58
1967   3.70   3.54
1968   3.76   3.66
1969   3.58   3.57
1970   3.57   3.59
1971   3.53   3.58
1972   3.14   3.36
1973   3.12   3.21
1974   3.31   3.36
1975   3.23   3.27
1976   3.11   3.03
1977   2.88   2.73
---- ------ ------

     1977 = 100%
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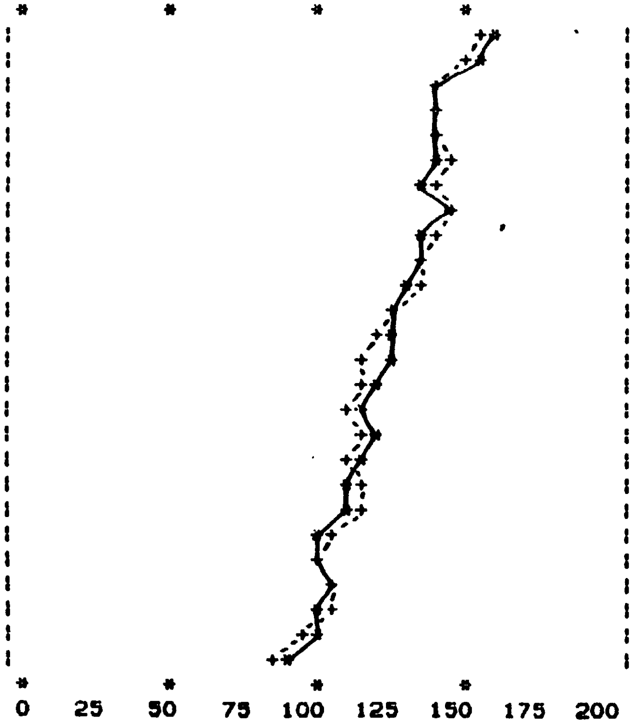

```
                         INVESTMENT

YEAR ACT(*) PRED(+)
---- ------ ------
1952   89.3  113.8
1953   87.6   97.5
1954   98.4  110.1
1955  120.5  117.8
1956  119.4   99.8
1957  131.0  119.3
1958  110.1   93.8
1959  103.8   84.1
1960  104.1  103.9
1961  100.1  113.2
1962  105.3  119.1
1963  144.1  147.9
1964  142.8  192.1
1965  188.6  183.6
1966  221.7  225.6
1967  216.9  207.9
1968  206.4  181.3
1969  203.6  199.2
1970  273.6  195.8
1971  203.7  205.3
1972  320.0  301.3
1973  318.0  345.8
1974  314.3  315.5
1975  218.4  238.8
1976  240.6  270.9
1977  307.9  306.9
---- ------ ------
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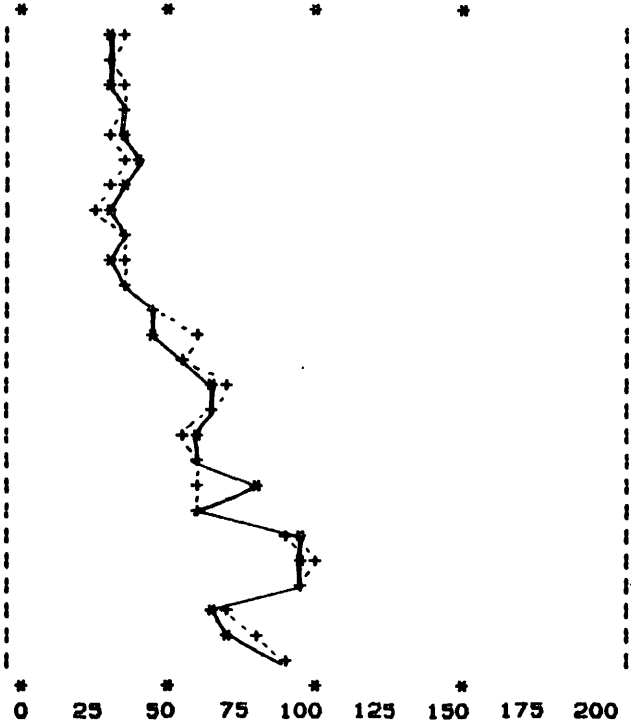
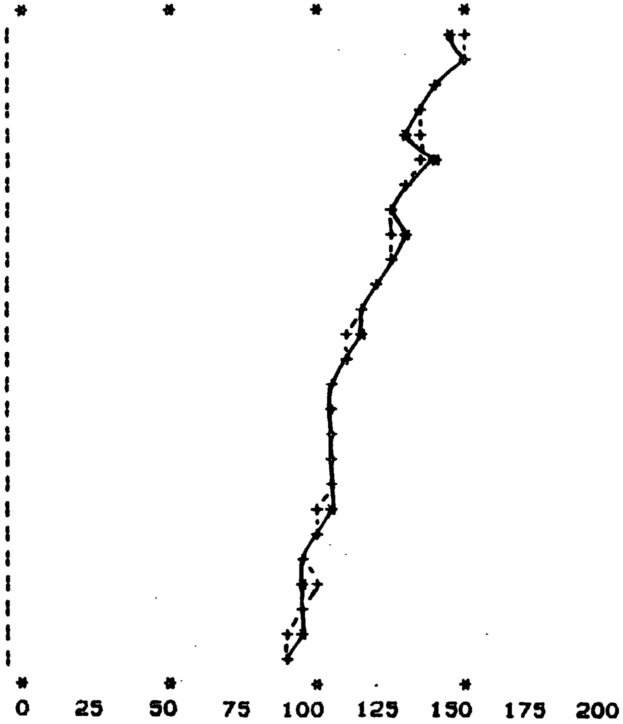


18 STONE, CLAY & GLASS (22)

EMPLOYMENT PER UNIT OF OUTPUT

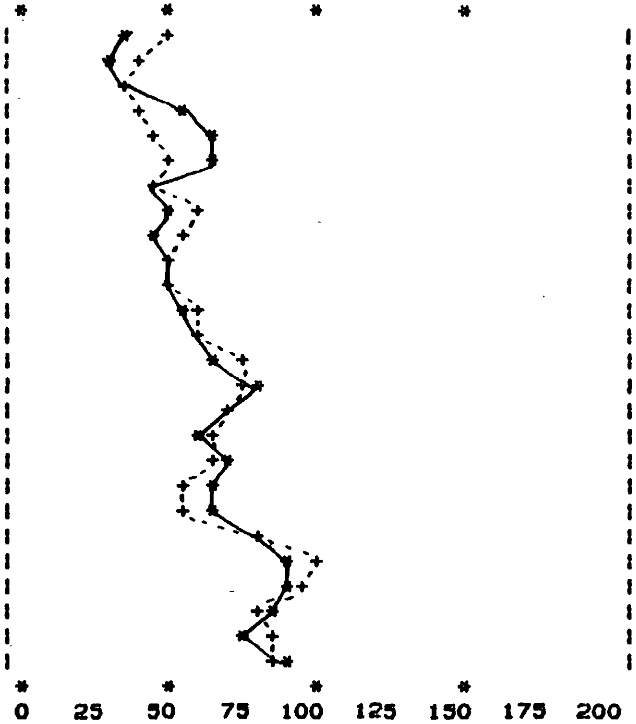
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 3.21 | 3.26 |
| 1953 | 3.28 | 3.23 |
| 1954 | 3.03 | 3.03 |
| 1955 | 2.93 | 2.90 |
| 1956 | 2.88 | 2.92 |
| 1957 | 3.01 | 2.95 |
| 1958 | 2.84 | 2.89 |
| 1959 | 2.72 | 2.76 |
| 1960 | 2.79 | 2.77 |
| 1961 | 2.69 | 2.71 |
| 1962 | 2.63 | 2.62 |
| 1963 | 2.48 | 2.51 |
| 1964 | 2.45 | 2.40 |
| 1965 | 2.35 | 2.34 |
| 1966 | 2.30 | 2.32 |
| 1967 | 2.30 | 2.29 |
| 1968 | 2.26 | 2.27 |
| 1969 | 2.25 | 2.26 |
| 1970 | 2.25 | 2.26 |
| 1971 | 2.26 | 2.19 |
| 1972 | 2.12 | 2.14 |
| 1973 | 2.07 | 2.11 |
| 1974 | 2.11 | 2.11 |
| 1975 | 2.05 | 2.10 |
| 1976 | 2.02 | 2.00 |
| 1977 | 1.98 | 1.95 |



1977 = 100%

INVESTMENT

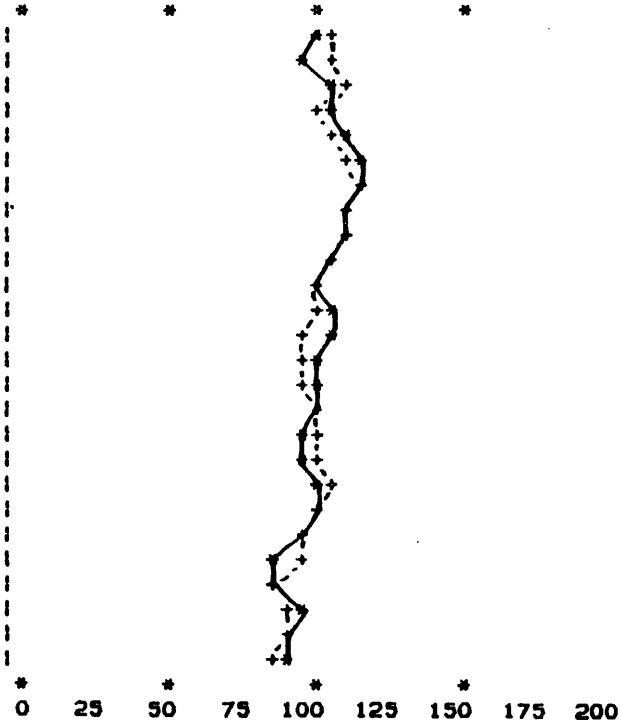
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 532.4 | 835.8 |
| 1953 | 523.7 | 703.6 |
| 1954 | 579.4 | 581.7 |
| 1955 | 933.6 | 685.3 |
| 1956 | 1144.9 | 765.1 |
| 1957 | 1089.7 | 823.8 |
| 1958 | 726.6 | 742.2 |
| 1959 | 816.1 | 1000.3 |
| 1960 | 787.2 | 906.2 |
| 1961 | 864.0 | 863.6 |
| 1962 | 820.7 | 805.9 |
| 1963 | 907.4 | 997.7 |
| 1964 | 995.6 | 1057.6 |
| 1965 | 1109.9 | 1256.4 |
| 1966 | 1379.6 | 1314.9 |
| 1967 | 1162.9 | 1189.0 |
| 1968 | 1022.2 | 1080.2 |
| 1969 | 1197.7 | 1059.9 |
| 1970 | 1124.4 | 969.0 |
| 1971 | 1068.6 | 912.4 |
| 1972 | 1376.3 | 1366.6 |
| 1973 | 1557.1 | 1735.3 |
| 1974 | 1529.0 | 1638.0 |
| 1975 | 1432.5 | 1360.9 |
| 1976 | 1305.7 | 1422.1 |
| 1977 | 1569.8 | 1483.4 |



19 IRON AND STEEL (23)

EMPLOYMENT PER UNIT OF OUTPUT

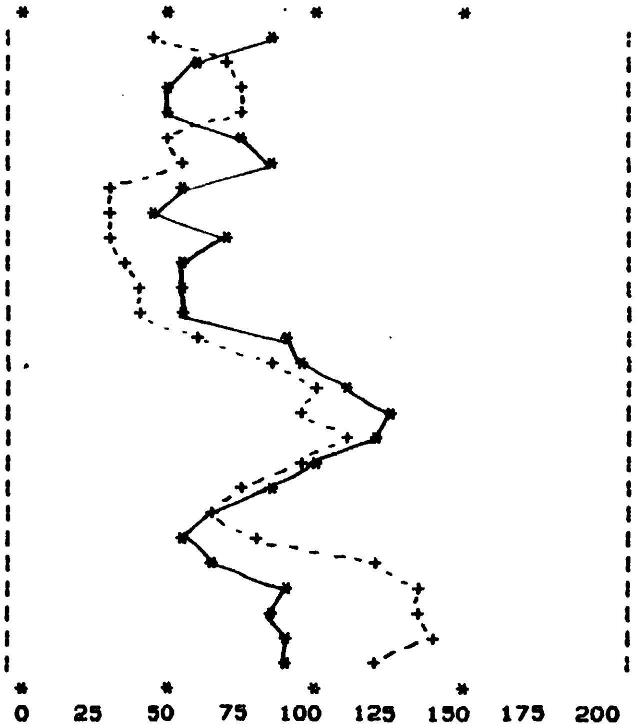
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 1.20 | 1.27 |
| 1953 | 1.14 | 1.28 |
| 1954 | 1.28 | 1.34 |
| 1955 | 1.31 | 1.25 |
| 1956 | 1.33 | 1.29 |
| 1957 | 1.38 | 1.34 |
| 1958 | 1.43 | 1.40 |
| 1959 | 1.32 | 1.34 |
| 1960 | 1.34 | 1.32 |
| 1961 | 1.31 | 1.27 |
| 1962 | 1.25 | 1.24 |
| 1963 | 1.30 | 1.19 |
| 1964 | 1.26 | 1.17 |
| 1965 | 1.21 | 1.16 |
| 1966 | 1.19 | 1.19 |
| 1967 | 1.21 | 1.21 |
| 1968 | 1.17 | 1.21 |
| 1969 | 1.18 | 1.22 |
| 1970 | 1.23 | 1.29 |
| 1971 | 1.21 | 1.25 |
| 1972 | 1.14 | 1.19 |
| 1973 | 1.04 | 1.14 |
| 1974 | 1.01 | 1.07 |
| 1975 | 1.16 | 1.10 |
| 1976 | 1.11 | 1.08 |
| 1977 | 1.12 | 1.05 |



1977 = 100%

INVESTMENT

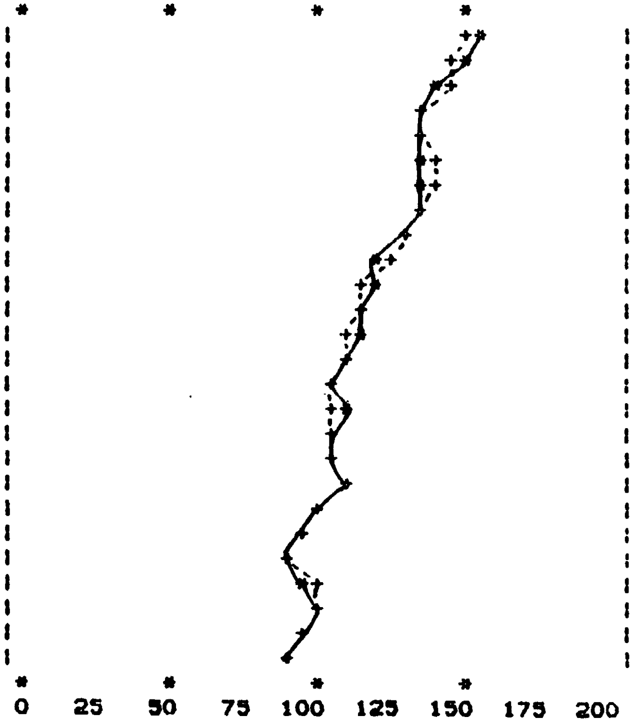
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 2190.6 | 1214.0 |
| 1953 | 1549.3 | 1797.3 |
| 1954 | 1259.7 | 1997.2 |
| 1955 | 1266.4 | 1935.4 |
| 1956 | 2009.3 | 1266.4 |
| 1957 | 2259.7 | 1399.0 |
| 1958 | 1417.5 | 793.1 |
| 1959 | 1131.2 | 793.4 |
| 1960 | 1882.2 | 801.1 |
| 1961 | 1363.8 | 860.5 |
| 1962 | 1362.3 | 1037.6 |
| 1963 | 1442.7 | 1071.5 |
| 1964 | 2360.8 | 1577.9 |
| 1965 | 2568.4 | 2230.5 |
| 1966 | 2983.5 | 2647.0 |
| 1967 | 3323.6 | 2570.3 |
| 1968 | 3191.9 | 2917.4 |
| 1969 | 2623.5 | 2513.0 |
| 1970 | 2242.2 | 1943.7 |
| 1971 | 1663.7 | 1751.9 |
| 1972 | 1465.0 | 2161.2 |
| 1973 | 1667.4 | 3166.2 |
| 1974 | 2309.4 | 3542.9 |
| 1975 | 2220.6 | 3663.6 |
| 1976 | 2417.2 | 3736.2 |
| 1977 | 2414.0 | 3197.9 |



20 NON-FERROUS METALS (24,25)

## EMPLOYMENT PER UNIT OF OUTPUT

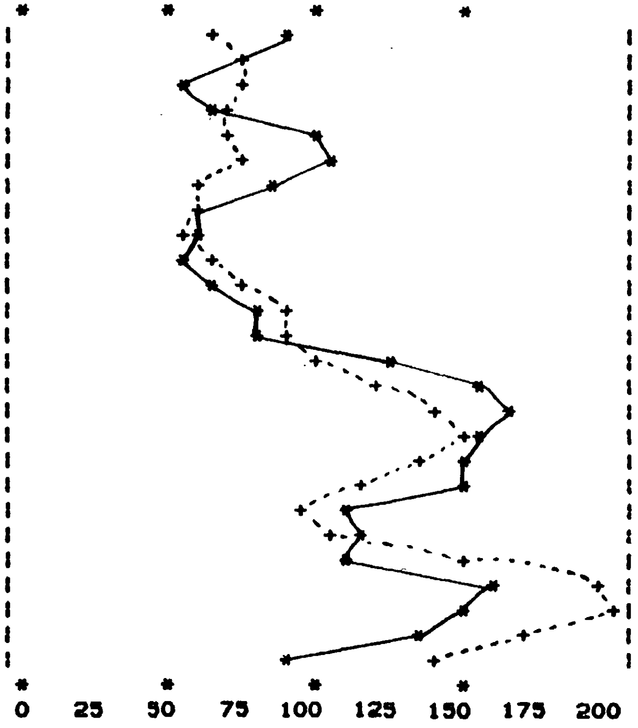
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 1.68 | 1.61 |
| 1953 | 1.59 | 1.58 |
| 1954 | 1.53 | 1.53 |
| 1955 | 1.45 | 1.46 |
| 1956 | 1.46 | 1.46 |
| 1957 | 1.45 | 1.49 |
| 1958 | 1.42 | 1.49 |
| 1959 | 1.43 | 1.45 |
| 1960 | 1.41 | 1.41 |
| 1961 | 1.28 | 1.34 |
| 1962 | 1.26 | 1.25 |
| 1963 | 1.21 | 1.25 |
| 1964 | 1.23 | 1.19 |
| 1965 | 1.20 | 1.15 |
| 1966 | 1.13 | 1.11 |
| 1967 | 1.18 | 1.12 |
| 1968 | 1.15 | 1.12 |
| 1969 | 1.14 | 1.14 |
| 1970 | 1.16 | 1.16 |
| 1971 | 1.09 | 1.07 |
| 1972 | 0.99 | 1.00 |
| 1973 | 0.94 | 0.98 |
| 1974 | 1.03 | 1.04 |
| 1975 | 1.04 | 1.06 |
| 1976 | 1.00 | 0.99 |
| 1977 | 0.97 | 0.93 |



1977 = 100%

## INVESTMENT

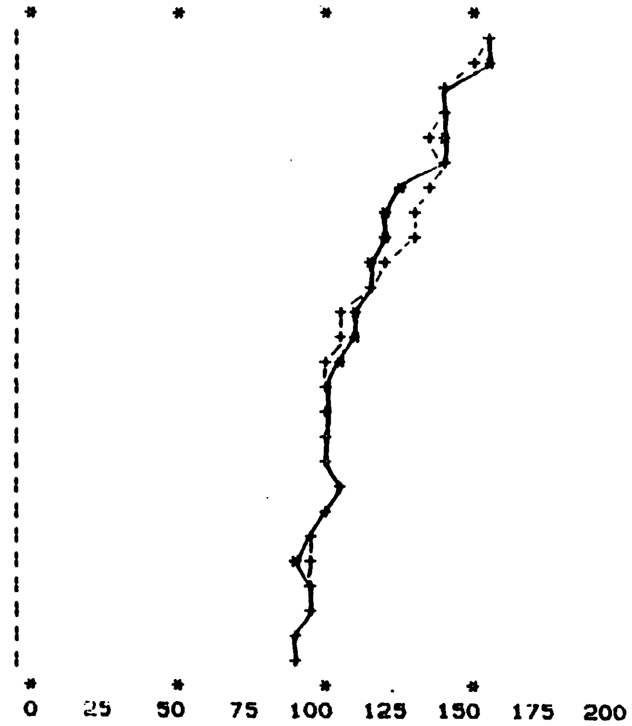
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 626.0 | 451.3 |
| 1953 | 507.5 | 509.5 |
| 1954 | 377.9 | 520.3 |
| 1955 | 435.2 | 496.3 |
| 1956 | 693.9 | 485.0 |
| 1957 | 738.3 | 505.5 |
| 1958 | 572.4 | 424.9 |
| 1959 | 423.6 | 406.1 |
| 1960 | 393.2 | 367.1 |
| 1961 | 383.9 | 456.2 |
| 1962 | 432.2 | 528.8 |
| 1963 | 539.3 | 621.6 |
| 1964 | 568.9 | 628.5 |
| 1965 | 856.2 | 684.4 |
| 1966 | 1075.8 | 833.3 |
| 1967 | 1173.0 | 983.3 |
| 1968 | 1101.5 | 1053.3 |
| 1969 | 1063.2 | 942.8 |
| 1970 | 1065.8 | 804.2 |
| 1971 | 766.3 | 646.8 |
| 1972 | 809.9 | 737.8 |
| 1973 | 762.0 | 1067.4 |
| 1974 | 1128.2 | 1355.0 |
| 1975 | 1041.5 | 1415.2 |
| 1976 | 955.0 | 1203.9 |
| 1977 | 633.3 | 995.6 |



## 21 METAL PRODUCTS (26)

### EMPLOYMENT PER UNIT OF OUTPUT

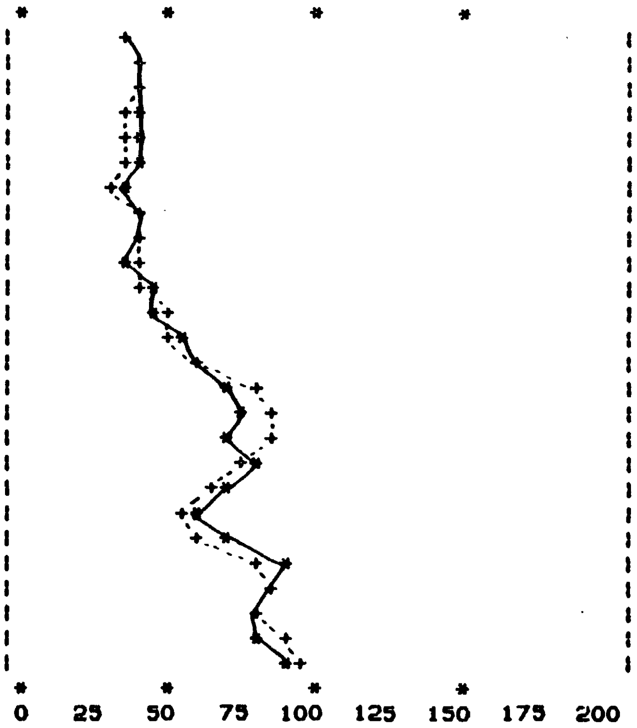
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 3.25 | 3.25 |
| 1953 | 3.20 | 3.11 |
| 1954 | 2.96 | 2.96 |
| 1955 | 2.94 | 2.89 |
| 1956 | 2.87 | 2.85 |
| 1957 | 2.95 | 2.90 |
| 1958 | 2.57 | 2.79 |
| 1959 | 2.51 | 2.70 |
| 1960 | 2.53 | 2.67 |
| 1961 | 2.43 | 2.51 |
| 1962 | 2.41 | 2.33 |
| 1963 | 2.29 | 2.17 |
| 1964 | 2.26 | 2.14 |
| 1965 | 2.15 | 2.09 |
| 1966 | 2.09 | 2.03 |
| 1967 | 2.05 | 2.02 |
| 1968 | 2.01 | 2.01 |
| 1969 | 2.08 | 2.02 |
| 1970 | 2.13 | 2.14 |
| 1971 | 2.01 | 2.07 |
| 1972 | 1.93 | 1.98 |
| 1973 | 1.90 | 1.94 |
| 1974 | 1.97 | 1.99 |
| 1975 | 2.01 | 1.99 |
| 1976 | 1.90 | 1.90 |
| 1977 | 1.88 | 1.82 |



1977 = 100%

### INVESTMENT

| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 768.1 | 796.9 |
| 1953 | 864.6 | 887.8 |
| 1954 | 912.1 | 954.1 |
| 1955 | 906.6 | 803.0 |
| 1956 | 896.6 | 745.3 |
| 1957 | 895.7 | 756.9 |
| 1958 | 790.1 | 654.0 |
| 1959 | 862.0 | 897.2 |
| 1960 | 865.0 | 891.5 |
| 1961 | 769.6 | 892.1 |
| 1962 | 985.1 | 909.2 |
| 1963 | 1018.6 | 1101.9 |
| 1964 | 1276.4 | 1163.1 |
| 1965 | 1379.7 | 1435.6 |
| 1966 | 1639.6 | 1865.5 |
| 1967 | 1768.6 | 1958.8 |
| 1968 | 1663.4 | 1968.9 |
| 1969 | 1877.3 | 1792.1 |
| 1970 | 1601.5 | 1532.4 |
| 1971 | 1433.0 | 1268.9 |
| 1972 | 1639.0 | 1440.7 |
| 1973 | 2069.6 | 1845.2 |
| 1974 | 1973.7 | 1973.9 |
| 1975 | 1896.9 | 1860.4 |
| 1976 | 1891.1 | 2117.1 |
| 1977 | 2138.6 | 2270.4 |

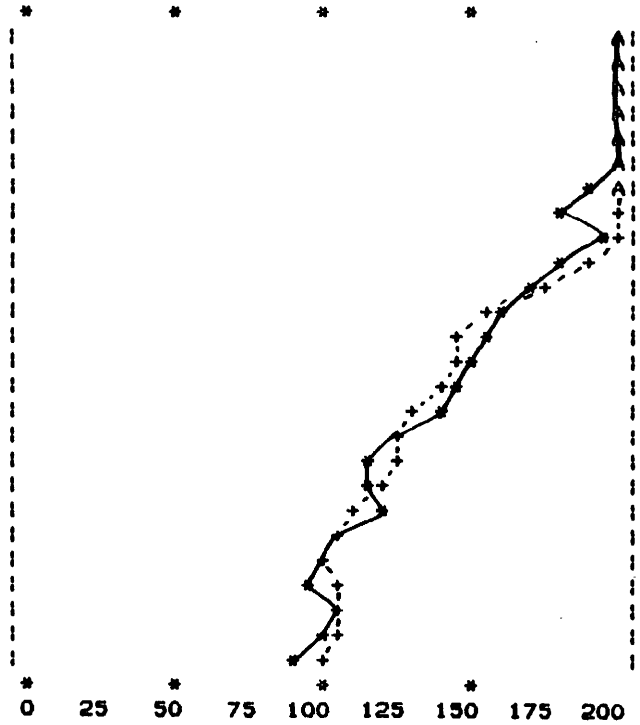


22 ENGINES & TURBINS (27)

## EMPLOYMENT PER UNIT OF OUTPUT

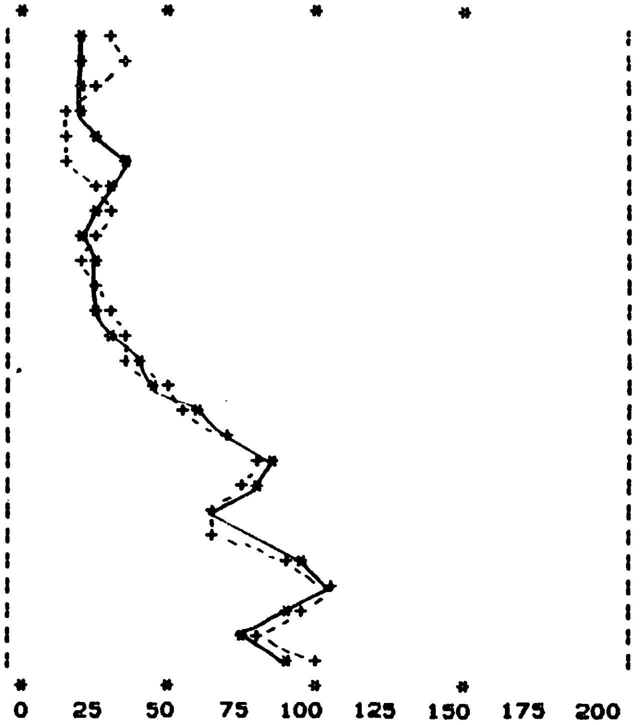
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 2.86 | 3.09 |
| 1953 | 2.81 | 2.98 |
| 1954 | 2.97 | 2.95 |
| 1955 | 3.10 | 3.07 |
| 1956 | 3.20 | 2.83 |
| 1957 | 3.13 | 2.59 |
| 1958 | 2.33 | 2.53 |
| 1959 | 2.21 | 2.45 |
| 1960 | 2.36 | 2.42 |
| 1961 | 2.19 | 2.31 |
| 1962 | 2.04 | 2.10 |
| 1963 | 1.97 | 1.90 |
| 1964 | 1.88 | 1.76 |
| 1965 | 1.83 | 1.79 |
| 1966 | 1.77 | 1.69 |
| 1967 | 1.68 | 1.59 |
| 1968 | 1.52 | 1.52 |
| 1969 | 1.40 | 1.54 |
| 1970 | 1.38 | 1.47 |
| 1971 | 1.45 | 1.35 |
| 1972 | 1.27 | 1.26 |
| 1973 | 1.19 | 1.19 |
| 1974 | 1.15 | 1.23 |
| 1975 | 1.28 | 1.23 |
| 1976 | 1.18 | 1.24 |
| 1977 | 1.10 | 1.17 |

1977 = 100%



## INVESTMENT

| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 61.2 | 95.6 |
| 1953 | 68.7 | 110.6 |
| 1954 | 64.2 | 80.0 |
| 1955 | 63.1 | 50.8 |
| 1956 | 73.5 | 46.9 |
| 1957 | 117.6 | 39.1 |
| 1958 | 95.0 | 75.0 |
| 1959 | 71.1 | 101.4 |
| 1960 | 52.6 | 86.5 |
| 1961 | 71.3 | 58.1 |
| 1962 | 70.8 | 80.1 |
| 1963 | 84.9 | 96.4 |
| 1964 | 94.1 | 107.3 |
| 1965 | 127.8 | 117.2 |
| 1966 | 145.7 | 165.1 |
| 1967 | 201.6 | 189.0 |
| 1968 | 241.9 | 233.3 |
| 1969 | 288.4 | 264.7 |
| 1970 | 276.1 | 245.2 |
| 1971 | 218.1 | 214.7 |
| 1972 | 209.8 | 224.7 |
| 1973 | 331.0 | 298.9 |
| 1974 | 361.5 | 351.0 |
| 1975 | 299.2 | 314.6 |
| 1976 | 261.3 | 278.7 |
| 1977 | 310.3 | 336.1 |

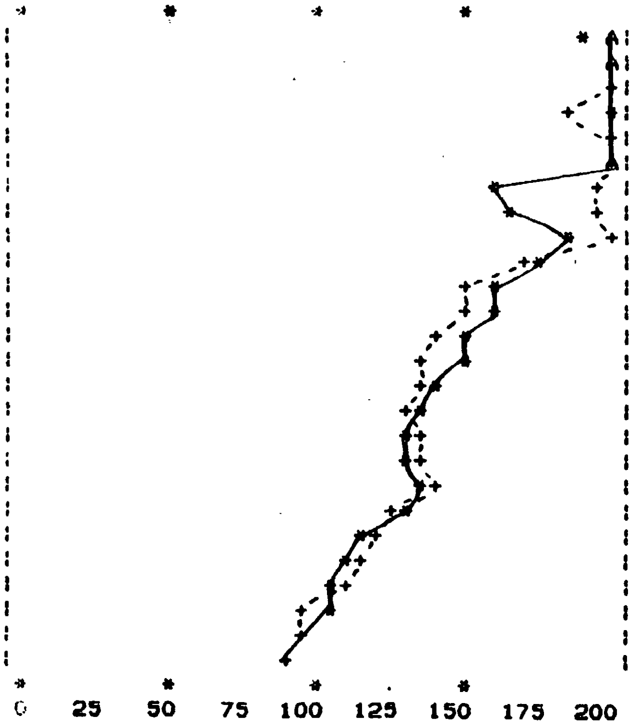


23 AGRICULTURE MACHINERY (28)

EMPLOYMENT PER UNIT OF OUTPUT

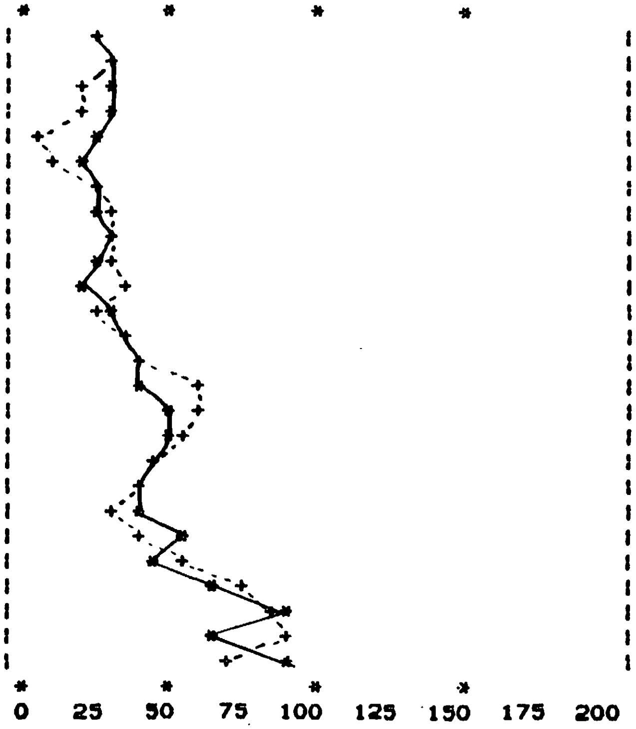
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 2.68 | 2.95 |
| 1953 | 2.88 | 3.04 |
| 1954 | 3.14 | 2.82 |
| 1955 | 2.84 | 2.64 |
| 1956 | 3.18 | 2.82 |
| 1957 | 3.17 | 3.03 |
| 1958 | 2.28 | 2.79 |
| 1959 | 2.36 | 2.79 |
| 1960 | 2.63 | 2.83 |
| 1961 | 2.48 | 2.40 |
| 1962 | 2.30 | 2.16 |
| 1963 | 2.27 | 2.11 |
| 1964 | 2.12 | 1.98 |
| 1965 | 2.14 | 1.89 |
| 1966 | 1.96 | 1.93 |
| 1967 | 1.90 | 1.82 |
| 1968 | 1.84 | 1.89 |
| 1969 | 1.87 | 1.91 |
| 1970 | 1.89 | 1.98 |
| 1971 | 1.85 | 1.77 |
| 1972 | 1.61 | 1.70 |
| 1973 | 1.54 | 1.65 |
| 1974 | 1.50 | 1.55 |
| 1975 | 1.46 | 1.36 |
| 1976 | 1.35 | 1.32 |
| 1977 | 1.28 | 1.24 |

1977 = 100%



INVESTMENT

| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 87.7 | 91.4 |
| 1953 | 107.7 | 104.6 |
| 1954 | 106.8 | 64.7 |
| 1955 | 102.9 | 74.4 |
| 1956 | 88.7 | 17.8 |
| 1957 | 77.5 | 26.6 |
| 1958 | 93.5 | 80.1 |
| 1959 | 82.4 | 99.8 |
| 1960 | 102.1 | 109.3 |
| 1961 | 79.7 | 114.9 |
| 1962 | 76.1 | 135.1 |
| 1963 | 108.0 | 89.1 |
| 1964 | 132.3 | 127.4 |
| 1965 | 155.2 | 142.0 |
| 1966 | 152.2 | 216.2 |
| 1967 | 191.2 | 216.9 |
| 1968 | 185.8 | 212.5 |
| 1969 | 165.7 | 167.0 |
| 1970 | 137.1 | 145.1 |
| 1971 | 137.4 | 101.4 |
| 1972 | 209.5 | 148.5 |
| 1973 | 163.1 | 215.3 |
| 1974 | 235.5 | 286.6 |
| 1975 | 349.0 | 326.8 |
| 1976 | 252.7 | 345.0 |
| 1977 | 348.1 | 269.5 |

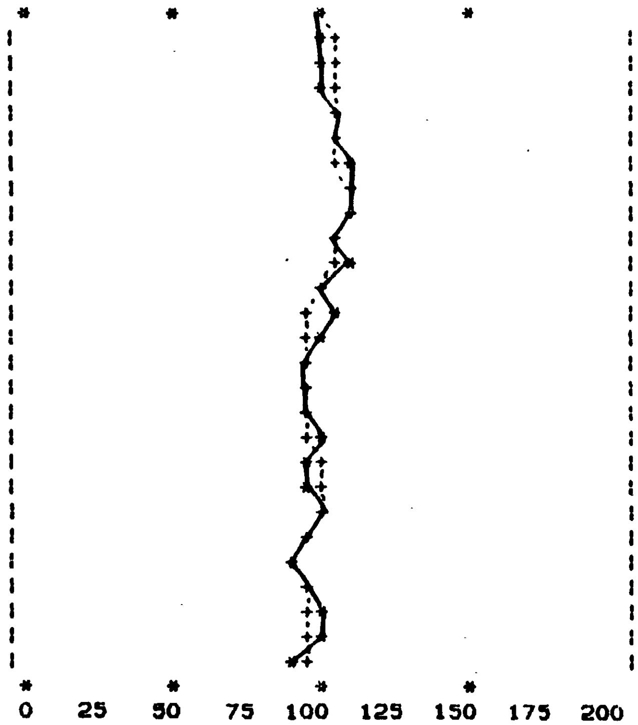


25 METALWORKING MACHINERY (30)

EMPLOYMENT PER UNIT OF OUTPUT

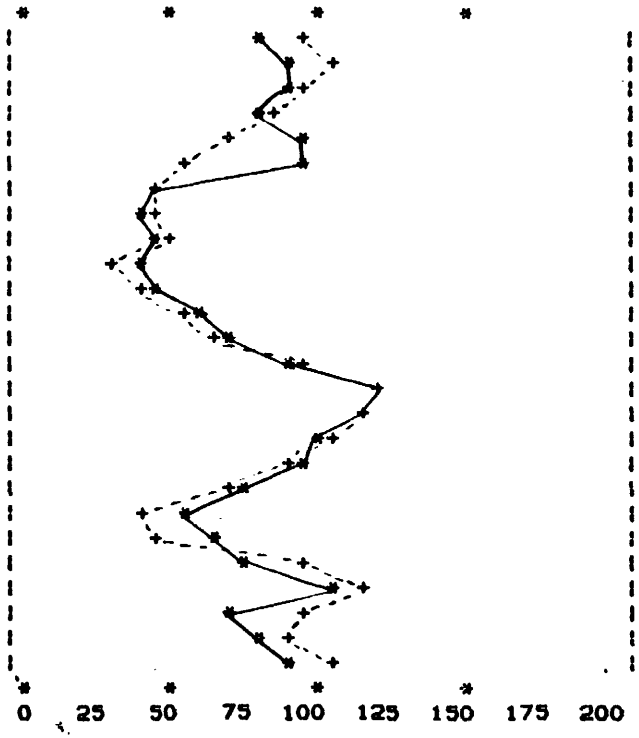
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 2.63 | 2.70 |
| 1953 | 2.55 | 2.74 |
| 1954 | 2.58 | 2.75 |
| 1955 | 2.78 | 2.70 |
| 1956 | 2.68 | 2.66 |
| 1957 | 2.88 | 2.71 |
| 1958 | 2.84 | 2.80 |
| 1959 | 2.80 | 2.80 |
| 1960 | 2.77 | 2.75 |
| 1961 | 2.80 | 2.75 |
| 1962 | 2.63 | 2.62 |
| 1963 | 2.67 | 2.53 |
| 1964 | 2.56 | 2.50 |
| 1965 | 2.43 | 2.45 |
| 1966 | 2.43 | 2.49 |
| 1967 | 2.49 | 2.50 |
| 1968 | 2.55 | 2.50 |
| 1969 | 2.46 | 2.53 |
| 1970 | 2.47 | 2.60 |
| 1971 | 2.63 | 2.60 |
| 1972 | 2.44 | 2.46 |
| 1973 | 2.29 | 2.36 |
| 1974 | 2.47 | 2.41 |
| 1975 | 2.58 | 2.52 |
| 1976 | 2.59 | 2.50 |
| 1977 | 2.36 | 2.48 |

1977 = 100%



INVESTMENT

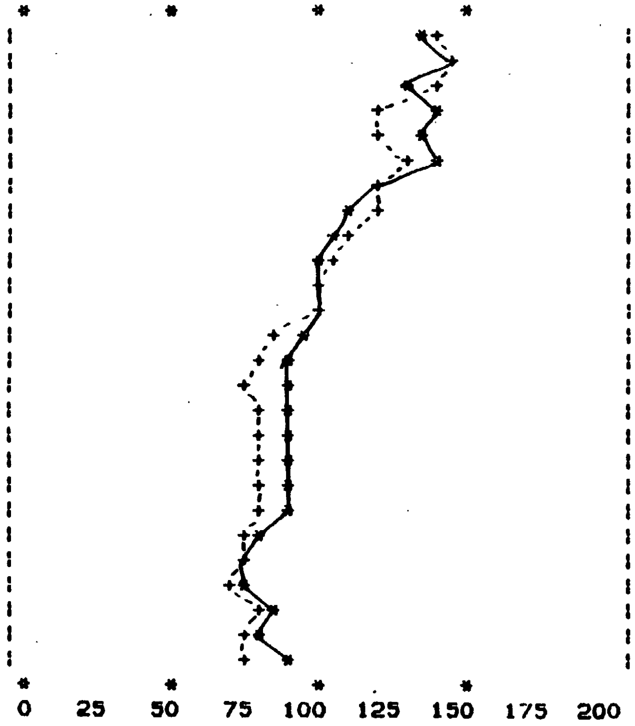
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 384.9 | 459.0 |
| 1953 | 418.5 | 499.2 |
| 1954 | 439.9 | 450.4 |
| 1955 | 384.5 | 407.4 |
| 1956 | 460.1 | 336.5 |
| 1957 | 458.3 | 261.1 |
| 1958 | 211.3 | 208.2 |
| 1959 | 180.0 | 202.6 |
| 1960 | 210.0 | 229.9 |
| 1961 | 185.1 | 137.5 |
| 1962 | 219.3 | 193.3 |
| 1963 | 274.9 | 265.7 |
| 1964 | 336.6 | 315.2 |
| 1965 | 426.3 | 453.1 |
| 1966 | 584.0 | 585.6 |
| 1967 | 541.8 | 553.7 |
| 1968 | 471.4 | 510.0 |
| 1969 | 450.2 | 420.7 |
| 1970 | 348.1 | 332.8 |
| 1971 | 265.0 | 173.9 |
| 1972 | 317.1 | 210.3 |
| 1973 | 360.8 | 445.9 |
| 1974 | 495.1 | 543.2 |
| 1975 | 329.0 | 446.2 |
| 1976 | 377.9 | 431.6 |
| 1977 | 436.2 | 493.1 |



## 27 SPECIAL INDUCTRY MACHINERY (31)

### EMPLOYMENT PER UNIT OF OUTPUT

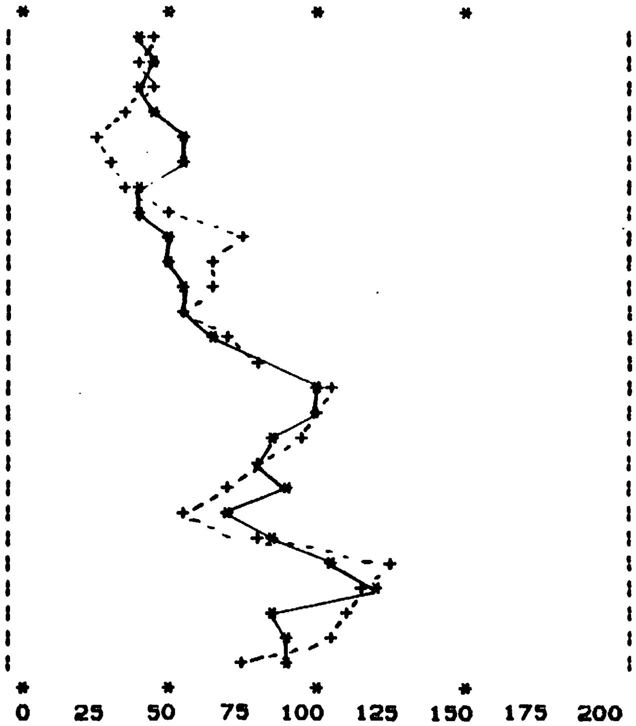
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 3.24 | 3.37 |
| 1953 | 3.43 | 3.44 |
| 1954 | 3.14 | 3.32 |
| 1955 | 3.33 | 2.91 |
| 1956 | 3.26 | 2.90 |
| 1957 | 3.35 | 3.05 |
| 1958 | 2.87 | 2.84 |
| 1959 | 2.66 | 2.80 |
| 1960 | 2.44 | 2.64 |
| 1961 | 2.34 | 2.53 |
| 1962 | 2.36 | 2.35 |
| 1963 | 2.42 | 2.33 |
| 1964 | 2.27 | 1.96 |
| 1965 | 2.16 | 1.90 |
| 1966 | 2.07 | 1.82 |
| 1967 | 2.18 | 1.94 |
| 1968 | 2.10 | 1.87 |
| 1969 | 2.13 | 1.86 |
| 1970 | 2.10 | 1.91 |
| 1971 | 2.08 | 1.87 |
| 1972 | 1.82 | 1.78 |
| 1973 | 1.74 | 1.75 |
| 1974 | 1.77 | 1.69 |
| 1975 | 1.94 | 1.84 |
| 1976 | 1.89 | 1.74 |
| 1977 | 2.15 | 1.78 |



1977 = 100%

### INVESTMENT

| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 99.2 | 111.0 |
| 1953 | 113.6 | 97.2 |
| 1954 | 95.4 | 103.8 |
| 1955 | 107.7 | 80.8 |
| 1956 | 139.1 | 54.4 |
| 1957 | 128.2 | 69.4 |
| 1958 | 95.8 | 78.7 |
| 1959 | 98.8 | 127.1 |
| 1960 | 118.1 | 179.9 |
| 1961 | 118.4 | 156.8 |
| 1962 | 133.9 | 155.6 |
| 1963 | 129.2 | 135.3 |
| 1964 | 161.1 | 171.1 |
| 1965 | 203.6 | 194.2 |
| 1966 | 246.8 | 257.0 |
| 1967 | 246.3 | 245.8 |
| 1968 | 213.0 | 231.5 |
| 1969 | 197.9 | 201.3 |
| 1970 | 225.2 | 171.5 |
| 1971 | 177.8 | 128.9 |
| 1972 | 208.9 | 198.2 |
| 1973 | 256.5 | 306.3 |
| 1974 | 296.4 | 286.0 |
| 1975 | 215.5 | 277.2 |
| 1976 | 217.6 | 264.2 |
| 1977 | 226.8 | 187.4 |

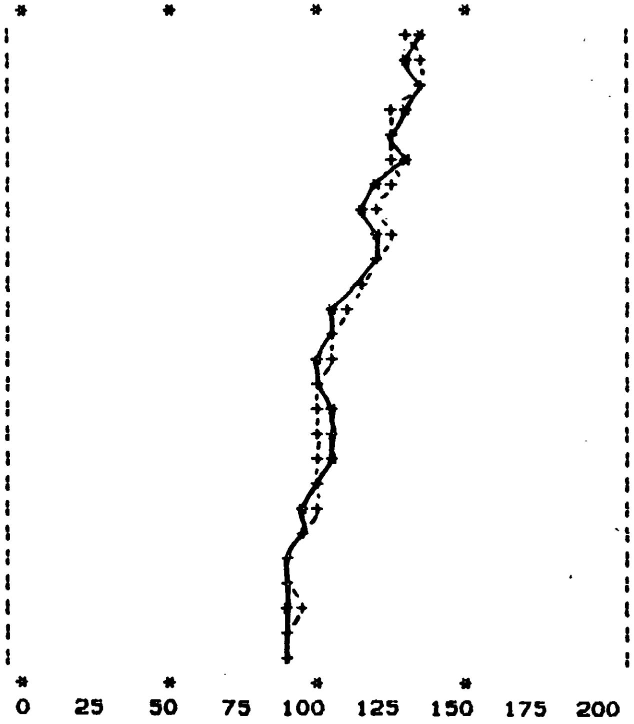


28 MISC. NONELEC. MACHINERY (29, 32)

## EMPLOYMENT PER UNIT OF OUTPUT

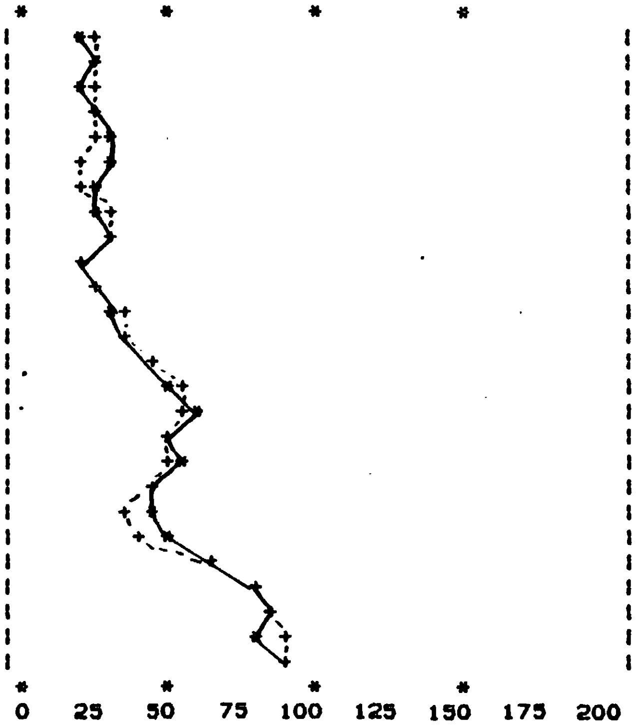
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 2.92 | 2.85 |
| 1953 | 2.84 | 2.90 |
| 1954 | 2.93 | 2.90 |
| 1955 | 2.79 | 2.72 |
| 1956 | 2.69 | 2.69 |
| 1957 | 2.78 | 2.72 |
| 1958 | 2.59 | 2.72 |
| 1959 | 2.46 | 2.62 |
| 1960 | 2.64 | 2.69 |
| 1961 | 2.63 | 2.56 |
| 1962 | 2.53 | 2.45 |
| 1963 | 2.29 | 2.35 |
| 1964 | 2.21 | 2.23 |
| 1965 | 2.17 | 2.21 |
| 1966 | 2.20 | 2.20 |
| 1967 | 2.21 | 2.19 |
| 1968 | 2.24 | 2.17 |
| 1969 | 2.22 | 2.18 |
| 1970 | 2.15 | 2.16 |
| 1971 | 2.09 | 2.10 |
| 1972 | 2.07 | 2.03 |
| 1973 | 1.93 | 1.94 |
| 1974 | 1.90 | 1.97 |
| 1975 | 1.98 | 1.99 |
| 1976 | 1.97 | 1.96 |
| 1977 | 1.96 | 1.93 |

1977 = 100%



## INVESTMENT

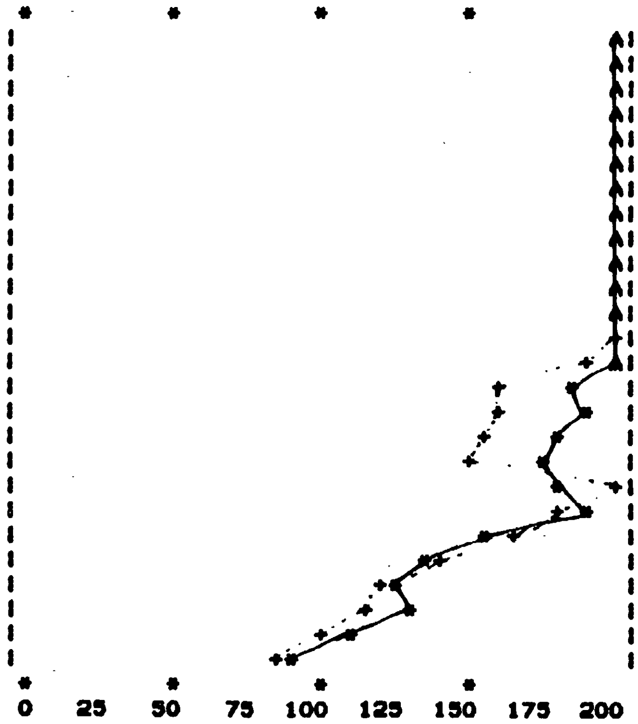
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 355.3 | 393.8 |
| 1953 | 407.9 | 450.0 |
| 1954 | 356.6 | 430.6 |
| 1955 | 433.8 | 436.2 |
| 1956 | 516.4 | 391.6 |
| 1957 | 493.1 | 362.1 |
| 1958 | 444.4 | 346.4 |
| 1959 | 470.2 | 487.2 |
| 1960 | 494.5 | 487.8 |
| 1961 | 381.6 | 383.0 |
| 1962 | 442.9 | 459.8 |
| 1963 | 500.6 | 651.2 |
| 1964 | 609.2 | 654.3 |
| 1965 | 795.4 | 826.8 |
| 1966 | 897.5 | 1052.5 |
| 1967 | 1102.6 | 1014.9 |
| 1968 | 905.8 | 918.2 |
| 1969 | 974.0 | 896.6 |
| 1970 | 852.2 | 825.8 |
| 1971 | 824.8 | 651.5 |
| 1972 | 898.5 | 754.3 |
| 1973 | 1158.9 | 1197.3 |
| 1974 | 1458.7 | 1491.7 |
| 1975 | 1588.7 | 1620.5 |
| 1976 | 1484.6 | 1663.6 |
| 1977 | 1708.1 | 1708.8 |



# 29 COMPUTERS & OTHER OFFICE MACHINERY (

## EMPLOYMENT PER UNIT OF OUTPUT

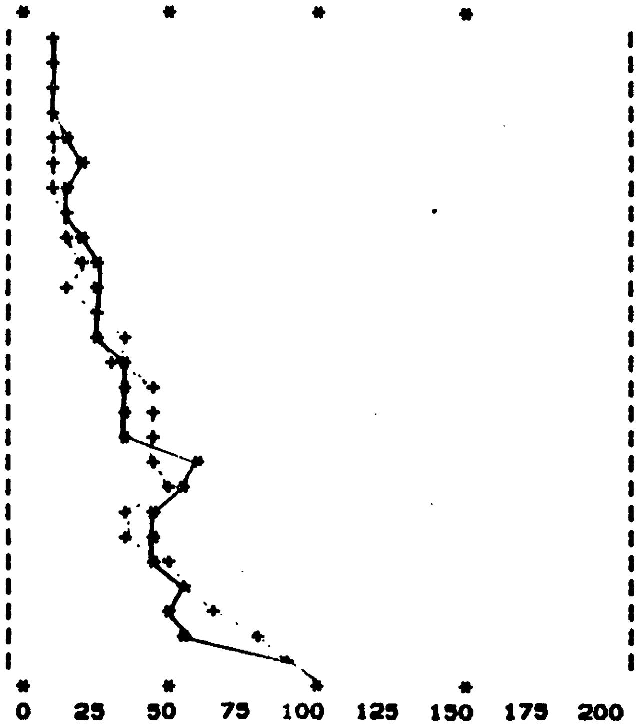
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 12.75 | 12.60 |
| 1953 | 11.99 | 11.79 |
| 1954 | 10.70 | 10.68 |
| 1955 | 10.18 | 9.72 |
| 1956 | 10.24 | 9.19 |
| 1957 | 8.79 | 8.61 |
| 1958 | 7.11 | 8.40 |
| 1959 | 7.02 | 8.22 |
| 1960 | 6.58 | 7.71 |
| 1961 | 6.16 | 6.64 |
| 1962 | 5.85 | 6.02 |
| 1963 | 4.65 | 4.97 |
| 1964 | 4.30 | 4.16 |
| 1965 | 4.52 | 3.90 |
| 1966 | 3.83 | 3.37 |
| 1967 | 3.97 | 3.33 |
| 1968 | 3.78 | 3.26 |
| 1969 | 3.59 | 3.12 |
| 1970 | 3.73 | 4.14 |
| 1971 | 3.92 | 3.77 |
| 1972 | 3.24 | 3.41 |
| 1973 | 2.83 | 2.85 |
| 1974 | 2.55 | 2.50 |
| 1975 | 2.67 | 2.34 |
| 1976 | 2.28 | 2.10 |
| 1977 | 1.87 | 1.75 |



1977 = 100%

## INVESTMENT

| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 58.2 | 49.0 |
| 1953 | 79.2 | 68.5 |
| 1954 | 76.6 | 79.2 |
| 1955 | 85.3 | 61.3 |
| 1956 | 118.4 | 55.9 |
| 1957 | 169.8 | 76.6 |
| 1958 | 119.8 | 81.4 |
| 1959 | 107.3 | 104.8 |
| 1960 | 139.7 | 119.1 |
| 1961 | 177.9 | 139.2 |
| 1962 | 190.3 | 132.2 |
| 1963 | 205.6 | 209.4 |
| 1964 | 187.6 | 266.0 |
| 1965 | 279.9 | 261.4 |
| 1966 | 285.0 | 366.6 |
| 1967 | 286.9 | 372.2 |
| 1968 | 305.4 | 362.5 |
| 1969 | 491.3 | 376.3 |
| 1970 | 472.3 | 411.5 |
| 1971 | 394.1 | 282.4 |
| 1972 | 358.0 | 293.5 |
| 1973 | 372.0 | 419.9 |
| 1974 | 463.7 | 462.9 |
| 1975 | 400.1 | 567.2 |
| 1976 | 471.2 | 688.4 |
| 1977 | 786.5 | 775.0 |

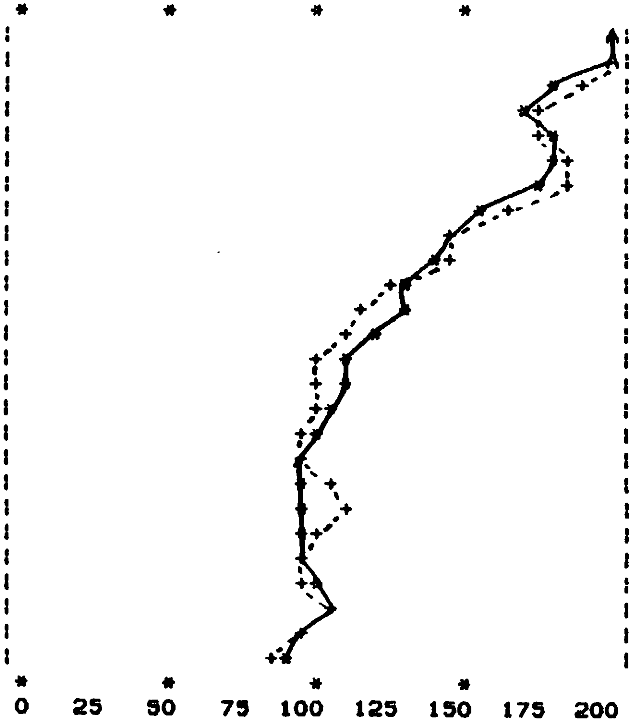


30 SERVICE INDUCTRY MACHINERY (35)

## EMPLOYMENT PER UNIT OF OUTPUT

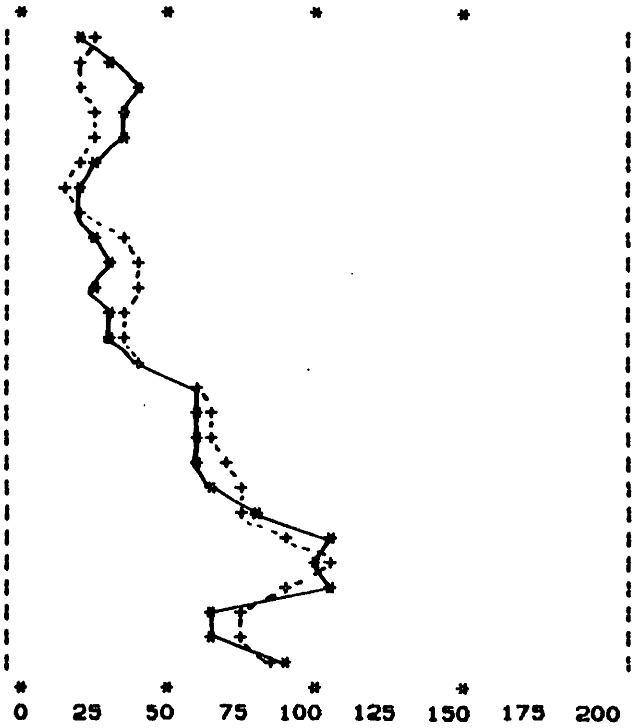
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 3.96 | 3.79 |
| 1953 | 3.48 | 3.48 |
| 1954 | 3.06 | 3.23 |
| 1955 | 2.91 | 3.00 |
| 1956 | 3.09 | 2.98 |
| 1957 | 3.07 | 3.10 |
| 1958 | 2.94 | 3.15 |
| 1959 | 2.62 | 2.76 |
| 1960 | 2.44 | 2.47 |
| 1961 | 2.32 | 2.44 |
| 1962 | 2.21 | 2.14 |
| 1963 | 2.15 | 1.90 |
| 1964 | 2.02 | 1.84 |
| 1965 | 1.84 | 1.70 |
| 1966 | 1.82 | 1.65 |
| 1967 | 1.77 | 1.67 |
| 1968 | 1.70 | 1.63 |
| 1969 | 1.60 | 1.55 |
| 1970 | 1.63 | 1.78 |
| 1971 | 1.56 | 1.85 |
| 1972 | 1.57 | 1.68 |
| 1973 | 1.58 | 1.60 |
| 1974 | 1.64 | 1.61 |
| 1975 | 1.80 | 1.75 |
| 1976 | 1.61 | 1.59 |
| 1977 | 1.53 | 1.46 |

1977 = 100%



## INVESTMENT

| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 61.7 | 63.6 |
| 1953 | 88.8 | 47.1 |
| 1954 | 122.0 | 57.5 |
| 1955 | 94.6 | 64.7 |
| 1956 | 106.1 | 72.1 |
| 1957 | 72.5 | 58.1 |
| 1958 | 53.6 | 35.1 |
| 1959 | 59.7 | 59.1 |
| 1960 | 66.9 | 106.1 |
| 1961 | 93.4 | 120.6 |
| 1962 | 75.6 | 116.0 |
| 1963 | 78.6 | 104.8 |
| 1964 | 80.0 | 98.2 |
| 1965 | 118.0 | 122.4 |
| 1966 | 175.6 | 173.4 |
| 1967 | 183.1 | 201.4 |
| 1968 | 183.1 | 199.1 |
| 1969 | 185.2 | 206.6 |
| 1970 | 189.9 | 221.6 |
| 1971 | 248.2 | 231.8 |
| 1972 | 315.2 | 271.5 |
| 1973 | 303.3 | 315.8 |
| 1974 | 316.5 | 273.0 |
| 1975 | 198.4 | 230.4 |
| 1976 | 190.4 | 223.7 |
| 1977 | 278.8 | 265.7 |

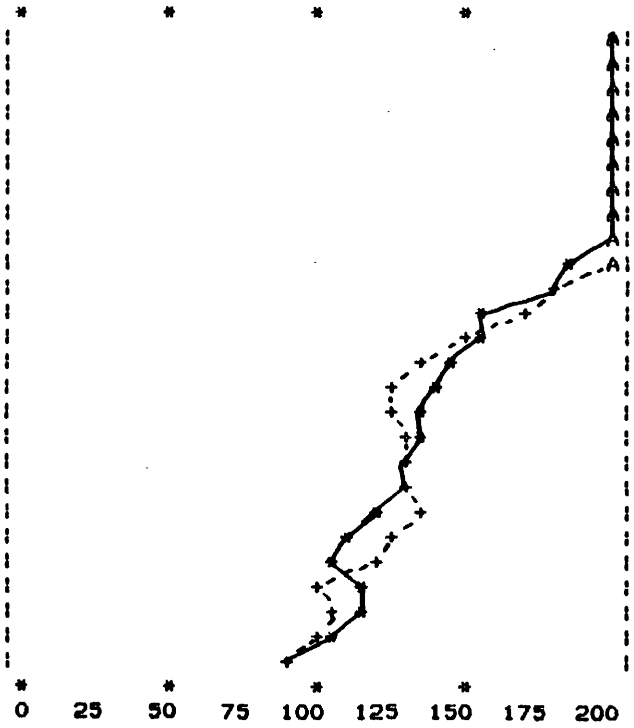


## 31 COMMUNICATIONS MACHINERY (36)

### EMPLOYMENT PER UNIT OF OUTPUT

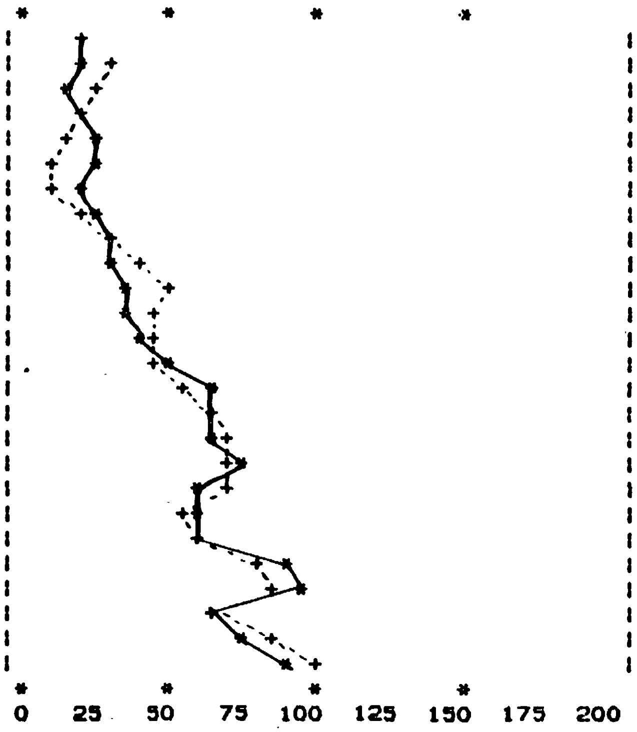
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 7.80 | 7.88 |
| 1953 | 6.89 | 7.27 |
| 1954 | 7.03 | 7.23 |
| 1955 | 7.01 | 7.05 |
| 1956 | 7.12 | 6.48 |
| 1957 | 7.08 | 6.06 |
| 1958 | 5.89 | 6.12 |
| 1959 | 5.76 | 5.91 |
| 1960 | 5.23 | 5.58 |
| 1961 | 4.73 | 5.25 |
| 1962 | 4.59 | 4.62 |
| 1963 | 3.89 | 4.26 |
| 1964 | 3.89 | 3.75 |
| 1965 | 3.60 | 3.39 |
| 1966 | 3.50 | 3.11 |
| 1967 | 3.47 | 3.11 |
| 1968 | 3.35 | 3.25 |
| 1969 | 3.27 | 3.23 |
| 1970 | 3.22 | 3.30 |
| 1971 | 3.07 | 3.35 |
| 1972 | 2.83 | 3.20 |
| 1973 | 2.64 | 2.97 |
| 1974 | 2.86 | 2.57 |
| 1975 | 2.84 | 2.63 |
| 1976 | 2.59 | 2.46 |
| 1977 | 2.29 | 2.26 |

1977 = 100%



### INVESTMENT

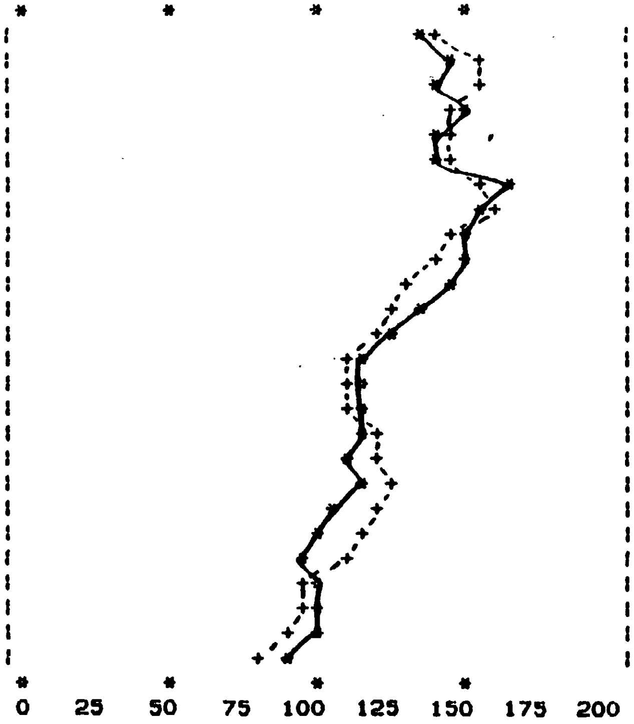
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 354.1 | 306.1 |
| 1953 | 292.3 | 468.0 |
| 1954 | 234.5 | 382.2 |
| 1955 | 319.9 | 279.6 |
| 1956 | 362.8 | 197.2 |
| 1957 | 418.0 | 143.7 |
| 1958 | 313.3 | 94.4 |
| 1959 | 418.0 | 296.5 |
| 1960 | 518.1 | 533.0 |
| 1961 | 474.8 | 677.7 |
| 1962 | 543.6 | 839.2 |
| 1963 | 618.8 | 809.0 |
| 1964 | 648.2 | 785.0 |
| 1965 | 875.3 | 770.4 |
| 1966 | 1129.3 | 947.3 |
| 1967 | 1126.6 | 1110.3 |
| 1968 | 1111.5 | 1174.8 |
| 1969 | 1285.4 | 1217.5 |
| 1970 | 1061.6 | 1253.8 |
| 1971 | 1071.5 | 936.2 |
| 1972 | 1078.4 | 1041.3 |
| 1973 | 1540.6 | 1389.8 |
| 1974 | 1628.8 | 1468.2 |
| 1975 | 1156.8 | 1160.2 |
| 1976 | 1327.8 | 1470.8 |
| 1977 | 1602.1 | 1760.3 |



## 32 HEAVY ELECTRICAL MACHINERY (37)

### EMPLOYMENT PER UNIT OF OUTPUT

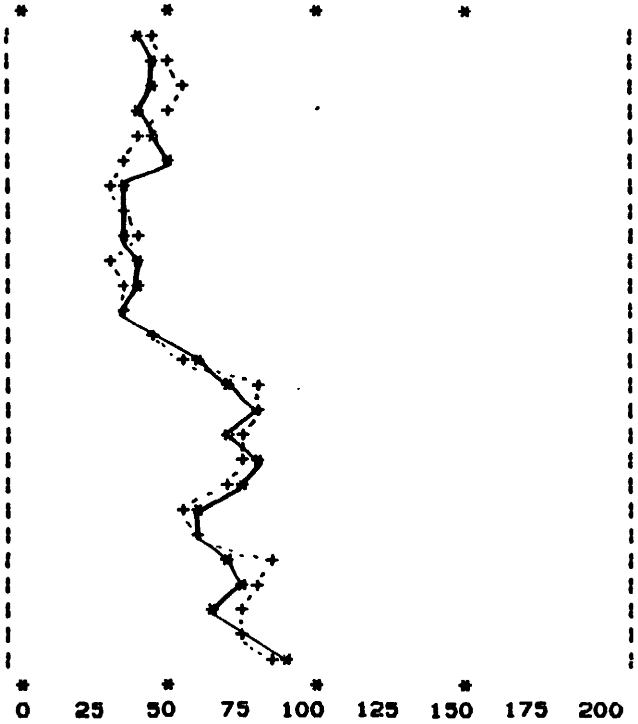
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 2.90 | 3.00 |
| 1953 | 3.04 | 3.28 |
| 1954 | 3.02 | 3.26 |
| 1955 | 3.20 | 3.07 |
| 1956 | 2.99 | 3.09 |
| 1957 | 2.98 | 3.13 |
| 1958 | 3.48 | 3.31 |
| 1959 | 3.32 | 3.38 |
| 1960 | 3.23 | 3.04 |
| 1961 | 3.20 | 2.95 |
| 1962 | 3.05 | 2.75 |
| 1963 | 2.91 | 2.62 |
| 1964 | 2.68 | 2.52 |
| 1965 | 2.46 | 2.33 |
| 1966 | 2.44 | 2.35 |
| 1967 | 2.46 | 2.36 |
| 1968 | 2.44 | 2.49 |
| 1969 | 2.37 | 2.54 |
| 1970 | 2.38 | 2.61 |
| 1971 | 2.25 | 2.52 |
| 1972 | 2.16 | 2.46 |
| 1973 | 2.04 | 2.35 |
| 1974 | 2.06 | 2.05 |
| 1975 | 2.15 | 2.00 |
| 1976 | 2.09 | 1.93 |
| 1977 | 1.92 | 1.69 |



1977 = 100%

### INVESTMENT

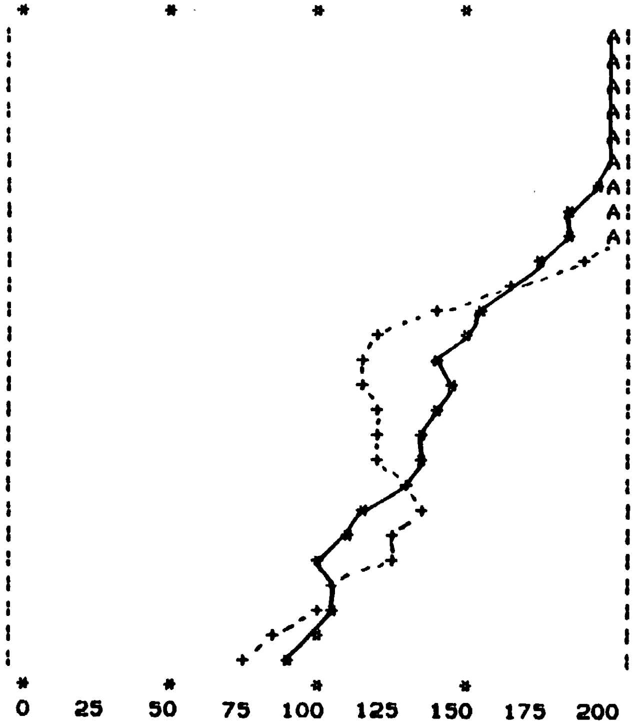
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 254.3 | 264.2 |
| 1953 | 283.1 | 302.7 |
| 1954 | 285.6 | 334.6 |
| 1955 | 244.9 | 295.4 |
| 1956 | 279.8 | 245.8 |
| 1957 | 310.2 | 219.0 |
| 1958 | 196.7 | 188.0 |
| 1959 | 203.6 | 207.2 |
| 1960 | 228.2 | 243.5 |
| 1961 | 234.6 | 181.2 |
| 1962 | 245.7 | 204.4 |
| 1963 | 229.1 | 210.6 |
| 1964 | 264.2 | 265.0 |
| 1965 | 365.6 | 347.6 |
| 1966 | 438.6 | 494.0 |
| 1967 | 513.1 | 503.1 |
| 1968 | 444.6 | 490.5 |
| 1969 | 512.0 | 468.5 |
| 1970 | 468.4 | 441.3 |
| 1971 | 390.5 | 349.6 |
| 1972 | 370.0 | 363.2 |
| 1973 | 447.3 | 549.7 |
| 1974 | 484.7 | 503.8 |
| 1975 | 415.0 | 479.4 |
| 1976 | 479.6 | 491.2 |
| 1977 | 582.3 | 528.4 |



## 33 HOUSEHOLD APPLIANCES (38)

### EMPLOYMENT PER UNIT OF OUTPUT

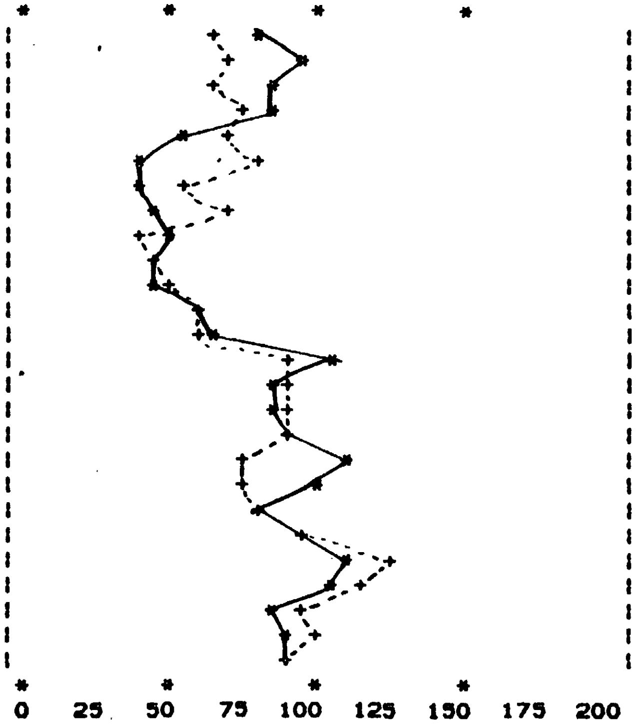
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 4.96 | 4.82 |
| 1953 | 4.93 | 4.68 |
| 1954 | 4.29 | 4.31 |
| 1955 | 3.97 | 3.95 |
| 1956 | 3.95 | 4.09 |
| 1957 | 4.18 | 4.32 |
| 1958 | 3.79 | 4.35 |
| 1959 | 3.59 | 4.17 |
| 1960 | 3.57 | 3.96 |
| 1961 | 3.44 | 3.73 |
| 1962 | 3.23 | 3.18 |
| 1963 | 3.01 | 2.69 |
| 1964 | 2.92 | 2.35 |
| 1965 | 2.70 | 2.26 |
| 1966 | 2.77 | 2.26 |
| 1967 | 2.68 | 2.34 |
| 1968 | 2.57 | 2.32 |
| 1969 | 2.58 | 2.31 |
| 1970 | 2.47 | 2.55 |
| 1971 | 2.24 | 2.63 |
| 1972 | 2.10 | 2.46 |
| 1973 | 1.94 | 2.38 |
| 1974 | 2.06 | 2.02 |
| 1975 | 2.01 | 1.88 |
| 1976 | 1.89 | 1.61 |
| 1977 | 1.75 | 1.40 |



1977 = 100%

### INVESTMENT

| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 181.1 | 142.4 |
| 1953 | 222.0 | 155.5 |
| 1954 | 192.1 | 150.0 |
| 1955 | 200.3 | 165.6 |
| 1956 | 122.9 | 157.2 |
| 1957 | 88.9 | 182.4 |
| 1958 | 88.7 | 123.7 |
| 1959 | 95.7 | 160.3 |
| 1960 | 113.8 | 90.0 |
| 1961 | 95.5 | 103.7 |
| 1962 | 97.4 | 112.8 |
| 1963 | 138.7 | 136.6 |
| 1964 | 142.2 | 141.0 |
| 1965 | 241.2 | 203.2 |
| 1966 | 193.1 | 210.8 |
| 1967 | 198.5 | 205.3 |
| 1968 | 203.8 | 209.8 |
| 1969 | 255.8 | 175.1 |
| 1970 | 226.8 | 168.4 |
| 1971 | 187.1 | 178.2 |
| 1972 | 220.4 | 222.5 |
| 1973 | 248.6 | 286.1 |
| 1974 | 239.7 | 266.8 |
| 1975 | 199.7 | 213.1 |
| 1976 | 202.1 | 235.8 |
| 1977 | 209.8 | 209.7 |

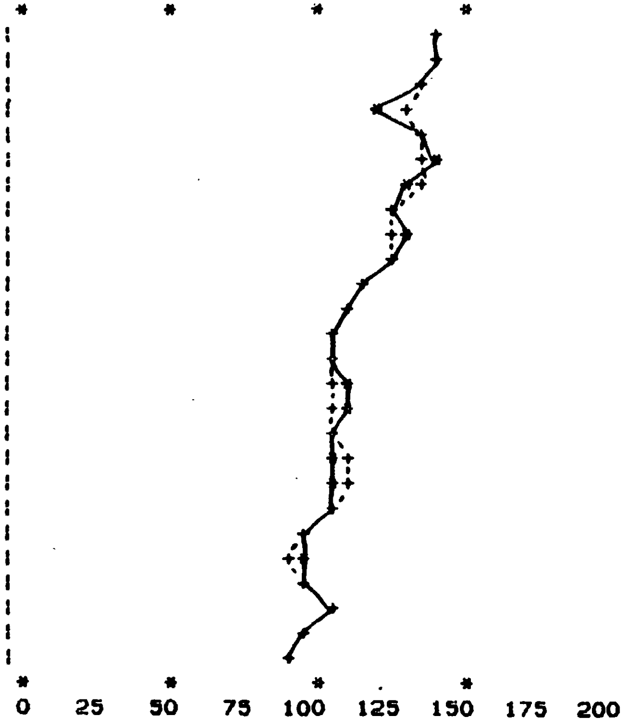


## 34 ELECTRICAL LIGHTING & WIRING EQUIP (

### EMPLOYMENT PER UNIT OF OUTPUT

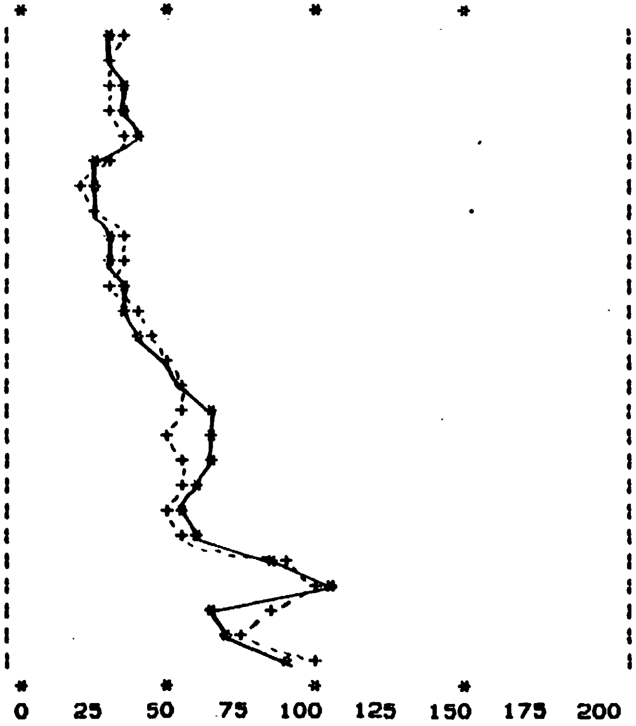
```
YEAR ACT(*) PRED(+)
---- ------ ------
1952   3.46   3.43
1953   3.49   3.50
1954   3.29   3.39
1955   2.98   3.16
1956   3.39   3.35
1957   3.47   3.36
1958   3.27   3.31
1959   3.13   3.04
1960   3.21   3.15
1961   3.08   3.07
1962   2.89   2.85
1963   2.77   2.77
1964   2.60   2.65
1965   2.61   2.61
1966   2.69   2.63
1967   2.75   2.64
1968   2.65   2.59
1969   2.58   2.65
1970   2.58   2.74
1971   2.53   2.55
1972   2.31   2.36
1973   2.28   2.27
1974   2.35   2.39
1975   2.61   2.57
1976   2.36   2.31
1977   2.25   2.26
---- ------ ------

    1977 = 100%
```



### INVESTMENT

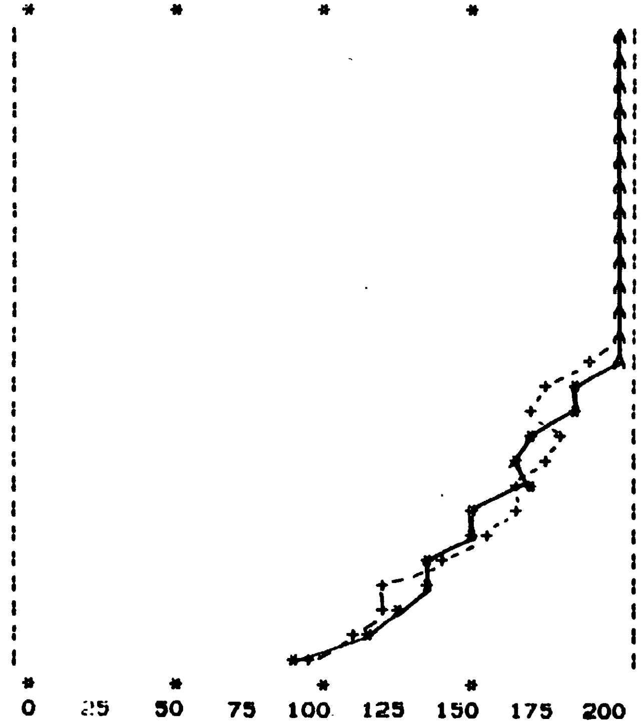
```
YEAR ACT(*) PRED(+)
---- ------ ------
1952  186.4  213.1
1953  172.6  191.7
1954  208.0  187.2
1955  203.0  187.9
1956  237.3  204.9
1957  138.2  182.5
1958  132.1  124.4
1959  145.8  152.0
1960  167.0  214.8
1961  162.2  197.9
1962  196.6  191.0
1963  194.8  246.6
1964  228.7  266.3
1965  300.1  297.5
1966  353.4  349.6
1967  389.5  347.2
1968  416.6  311.0
1969  401.5  325.5
1970  386.8  336.1
1971  332.1  290.8
1972  383.0  347.2
1973  543.4  557.8
1974  668.5  631.3
1975  416.5  521.7
1976  440.9  477.8
1977  574.0  625.3
---- ------ ------
```



35 RADIO, T. V. RECEIVING, PHONOGRAPH (40)

## EMPLOYMENT PER UNIT OF OUTPUT

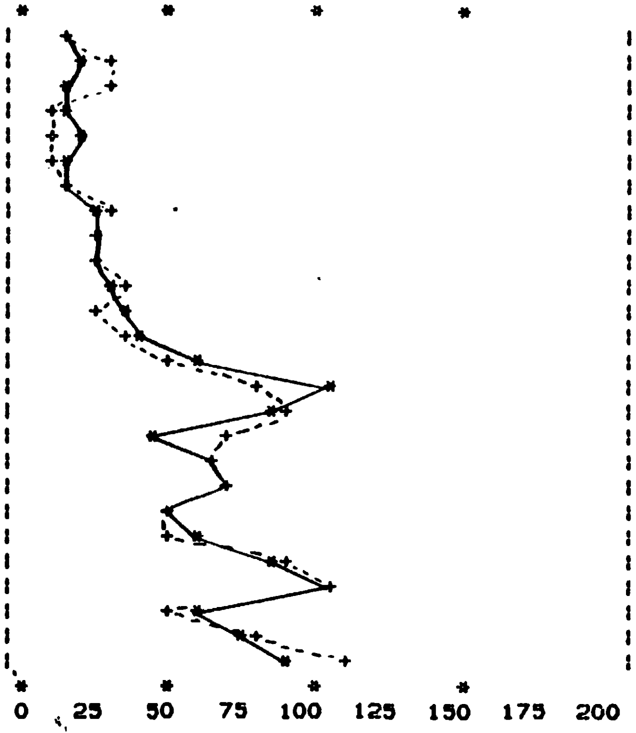
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 11.62 | 12.05 |
| 1953 | 10.50 | 11.81 |
| 1954 | 10.26 | 10.53 |
| 1955 | 10.96 | 10.65 |
| 1956 | 11.39 | 9.78 |
| 1957 | 11.14 | 8.56 |
| 1958 | 7.62 | 7.93 |
| 1959 | 7.09 | 7.47 |
| 1960 | 6.90 | 7.64 |
| 1961 | 6.26 | 7.32 |
| 1962 | 5.71 | 6.06 |
| 1963 | 5.35 | 5.36 |
| 1964 | 4.99 | 4.76 |
| 1965 | 4.53 | 4.27 |
| 1966 | 4.09 | 3.91 |
| 1967 | 4.17 | 3.82 |
| 1968 | 3.82 | 4.05 |
| 1969 | 3.70 | 3.91 |
| 1970 | 3.77 | 3.72 |
| 1971 | 3.37 | 3.70 |
| 1972 | 3.27 | 3.43 |
| 1973 | 2.97 | 3.12 |
| 1974 | 2.95 | 2.70 |
| 1975 | 2.75 | 2.60 |
| 1976 | 2.50 | 2.38 |
| 1977 | 2.01 | 2.10 |



1977 = 100%

## INVESTMENT

| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 20.8 | 23.0 |
| 1953 | 24.8 | 43.1 |
| 1954 | 20.1 | 41.0 |
| 1955 | 19.0 | 15.0 |
| 1956 | 24.7 | 9.3 |
| 1957 | 22.1 | 8.5 |
| 1958 | 22.7 | 20.9 |
| 1959 | 32.3 | 41.1 |
| 1960 | 33.2 | 36.5 |
| 1961 | 34.9 | 33.5 |
| 1962 | 40.7 | 49.5 |
| 1963 | 53.8 | 35.8 |
| 1964 | 58.9 | 52.9 |
| 1965 | 91.5 | 76.1 |
| 1966 | 159.4 | 118.8 |
| 1967 | 126.7 | 131.8 |
| 1968 | 67.8 | 101.5 |
| 1969 | 95.3 | 95.9 |
| 1970 | 100.8 | 107.3 |
| 1971 | 73.9 | 70.3 |
| 1972 | 90.6 | 74.4 |
| 1973 | 129.5 | 138.8 |
| 1974 | 160.5 | 161.5 |
| 1975 | 86.0 | 70.8 |
| 1976 | 113.4 | 120.3 |
| 1977 | 137.8 | 163.3 |

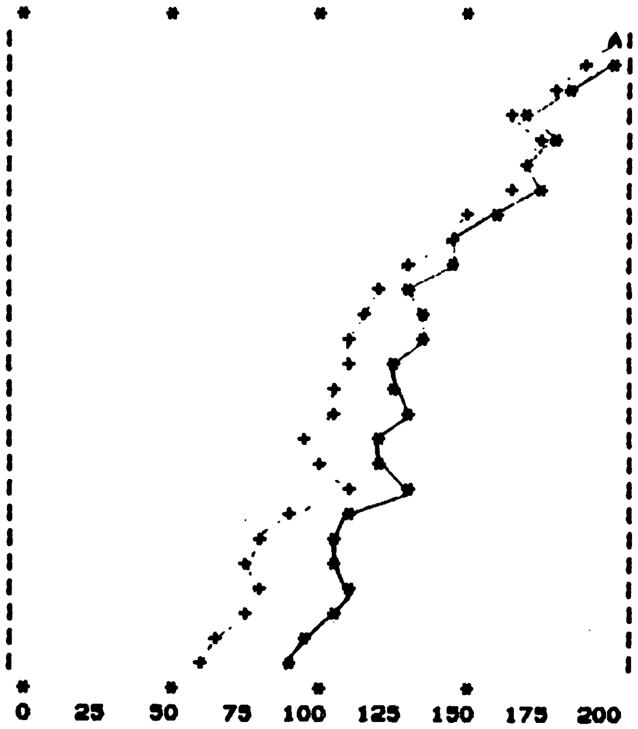


# 36 MOTOR VEHICLES (41)

## EMPLOYMENT PER UNIT OF OUTPUT

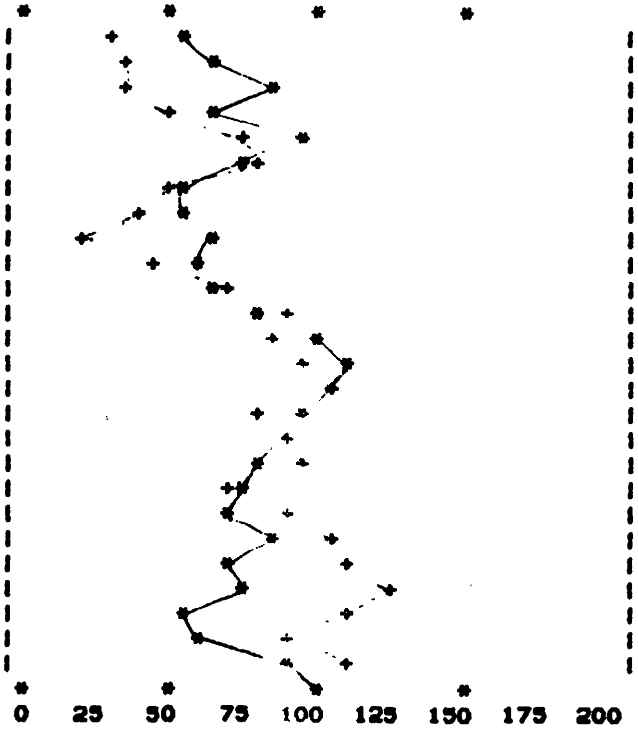
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 1.90 | 1.80 |
| 1953 | 1.77 | 1.67 |
| 1954 | 1.63 | 1.57 |
| 1955 | 1.50 | 1.44 |
| 1956 | 1.57 | 1.54 |
| 1957 | 1.47 | 1.49 |
| 1958 | 1.54 | 1.46 |
| 1959 | 1.39 | 1.30 |
| 1960 | 1.27 | 1.27 |
| 1961 | 1.26 | 1.15 |
| 1962 | 1.15 | 1.06 |
| 1963 | 1.19 | 1.01 |
| 1964 | 1.17 | 0.96 |
| 1965 | 1.09 | 0.94 |
| 1966 | 1.10 | 0.91 |
| 1967 | 1.14 | 0.89 |
| 1968 | 1.06 | 0.84 |
| 1969 | 1.07 | 0.86 |
| 1970 | 1.12 | 0.95 |
| 1971 | 0.95 | 0.78 |
| 1972 | 0.93 | 0.70 |
| 1973 | 0.89 | 0.66 |
| 1974 | 0.96 | 0.69 |
| 1975 | 0.92 | 0.63 |
| 1976 | 0.83 | 0.54 |
| 1977 | 0.79 | 0.50 |

1977 = 100%



## INVESTMENT

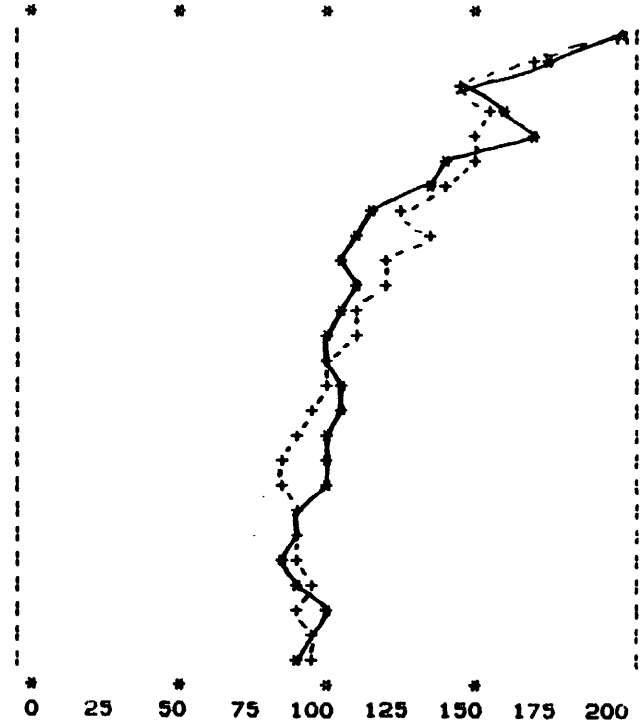
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 1791.3 | 949.2 |
| 1953 | 2293.9 | 1198.1 |
| 1954 | 2936.7 | 1219.4 |
| 1955 | 2263.2 | 1759.4 |
| 1956 | 3235.1 | 2559.2 |
| 1957 | 2638.4 | 2767.9 |
| 1958 | 1936.8 | 1775.4 |
| 1959 | 1940.2 | 1422.3 |
| 1960 | 2312.9 | 704.9 |
| 1961 | 1994.7 | 1484.6 |
| 1962 | 2298.3 | 2447.8 |
| 1963 | 2833.4 | 3069.6 |
| 1964 | 3517.3 | 2909.9 |
| 1965 | 3848.9 | 3224.4 |
| 1966 | 3680.1 | 3742.4 |
| 1967 | 3216.1 | 2807.3 |
| 1968 | 3210.6 | 3115.2 |
| 1969 | 2715.9 | 3269.1 |
| 1970 | 2517.5 | 2339.4 |
| 1971 | 2320.8 | 3063.6 |
| 1972 | 2864.9 | 3604.7 |
| 1973 | 2331.3 | 3890.7 |
| 1974 | 2634.9 | 4307.6 |
| 1975 | 1829.7 | 3766.5 |
| 1976 | 2016.2 | 3105.1 |
| 1977 | 3171.5 | 3847.1 |



37 AEROSPACE (42)

## EMPLOYMENT PER UNIT OF OUTPUT

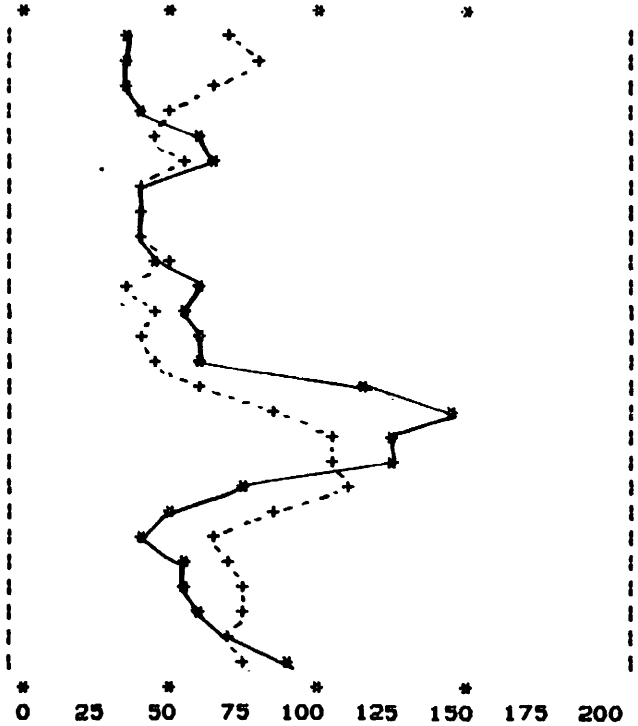
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 3.73 | 3.53 |
| 1953 | 3.02 | 2.93 |
| 1954 | 2.52 | 2.54 |
| 1955 | 2.77 | 2.70 |
| 1956 | 2.91 | 2.59 |
| 1957 | 2.42 | 2.63 |
| 1958 | 2.34 | 2.42 |
| 1959 | 2.02 | 2.16 |
| 1960 | 1.93 | 2.32 |
| 1961 | 1.80 | 2.04 |
| 1962 | 1.89 | 2.08 |
| 1963 | 1.80 | 1.91 |
| 1964 | 1.72 | 1.86 |
| 1965 | 1.73 | 1.75 |
| 1966 | 1.78 | 1.71 |
| 1967 | 1.81 | 1.64 |
| 1968 | 1.70 | 1.52 |
| 1969 | 1.74 | 1.48 |
| 1970 | 1.74 | 1.47 |
| 1971 | 1.56 | 1.52 |
| 1972 | 1.57 | 1.57 |
| 1973 | 1.47 | 1.57 |
| 1974 | 1.58 | 1.60 |
| 1975 | 1.69 | 1.53 |
| 1976 | 1.62 | 1.62 |
| 1977 | 1.57 | 1.66 |



1977 = 100%

## INVESTMENT

| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 311.2 | 707.0 |
| 1953 | 321.1 | 771.7 |
| 1954 | 317.9 | 634.3 |
| 1955 | 394.1 | 491.5 |
| 1956 | 574.0 | 429.7 |
| 1957 | 628.9 | 508.1 |
| 1958 | 401.2 | 403.2 |
| 1959 | 392.3 | 395.7 |
| 1960 | 377.7 | 367.8 |
| 1961 | 448.0 | 458.8 |
| 1962 | 575.9 | 344.5 |
| 1963 | 557.6 | 431.4 |
| 1964 | 598.6 | 362.6 |
| 1965 | 597.4 | 424.9 |
| 1966 | 1147.0 | 564.4 |
| 1967 | 1448.6 | 823.7 |
| 1968 | 1219.6 | 1061.8 |
| 1969 | 1224.7 | 1065.1 |
| 1970 | 725.0 | 1085.0 |
| 1971 | 487.3 | 847.3 |
| 1972 | 398.7 | 619.7 |
| 1973 | 510.4 | 695.6 |
| 1974 | 550.1 | 721.9 |
| 1975 | 586.3 | 730.5 |
| 1976 | 686.9 | 678.6 |
| 1977 | 902.2 | 758.0 |

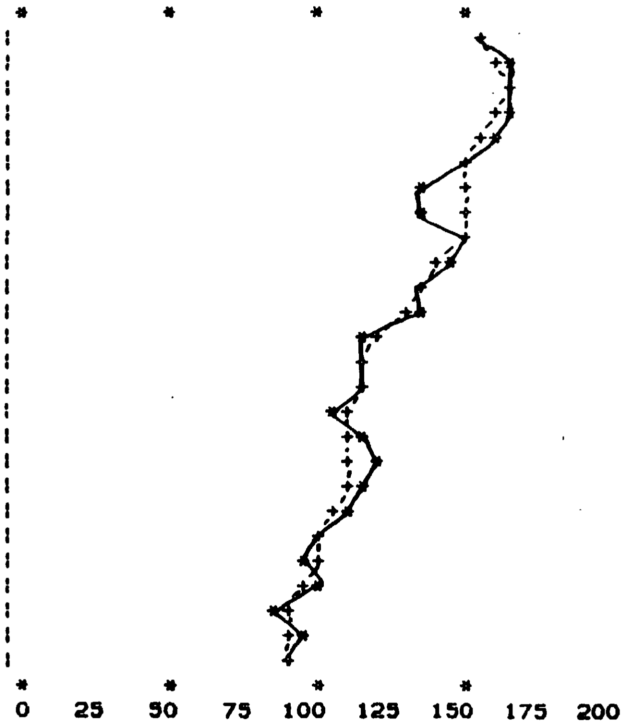


38 SHIPS & BOATS (43)

EMPLOYMENT PER UNIT OF OUTPUT

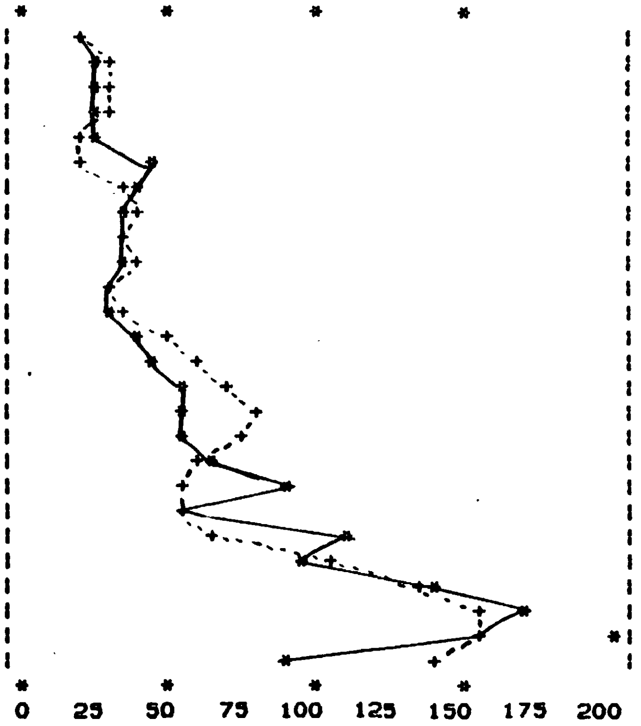
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 4.61 | 4.59 |
| 1953 | 4.81 | 4.63 |
| 1954 | 4.82 | 4.81 |
| 1955 | 4.82 | 4.75 |
| 1956 | 4.67 | 4.55 |
| 1957 | 4.41 | 4.44 |
| 1958 | 3.93 | 4.32 |
| 1959 | 4.01 | 4.39 |
| 1960 | 4.37 | 4.43 |
| 1961 | 4.27 | 4.08 |
| 1962 | 4.00 | 3.90 |
| 1963 | 3.93 | 3.77 |
| 1964 | 3.36 | 3.49 |
| 1965 | 3.29 | 3.40 |
| 1966 | 3.41 | 3.29 |
| 1967 | 2.99 | 3.21 |
| 1968 | 3.29 | 3.24 |
| 1969 | 3.46 | 3.26 |
| 1970 | 3.29 | 3.20 |
| 1971 | 3.14 | 3.00 |
| 1972 | 2.97 | 2.97 |
| 1973 | 2.72 | 2.91 |
| 1974 | 2.86 | 2.77 |
| 1975 | 2.46 | 2.65 |
| 1976 | 2.72 | 2.63 |
| 1977 | 2.65 | 2.60 |

1977 = 100%



INVESTMENT

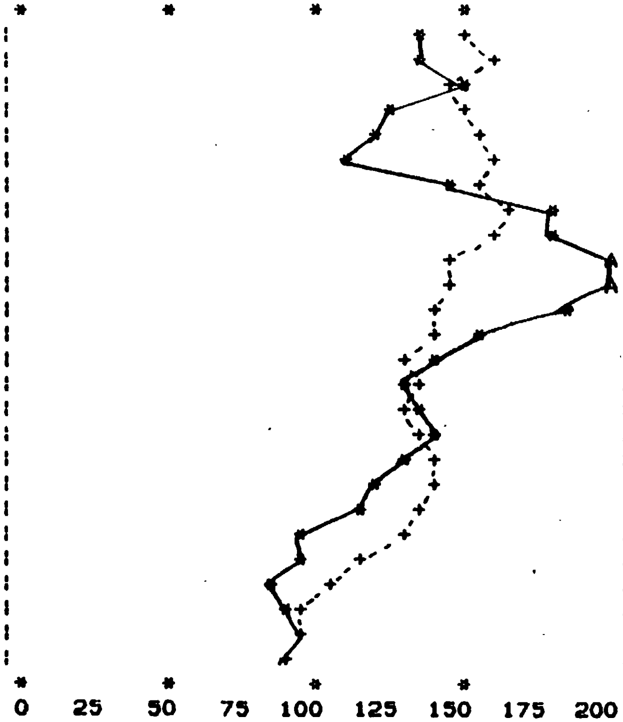
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 25.7 | 29.3 |
| 1953 | 36.2 | 48.5 |
| 1954 | 35.6 | 47.3 |
| 1955 | 36.5 | 45.5 |
| 1956 | 40.9 | 27.2 |
| 1957 | 68.9 | 27.2 |
| 1958 | 61.0 | 56.1 |
| 1959 | 53.6 | 60.0 |
| 1960 | 58.8 | 57.5 |
| 1961 | 58.3 | 60.8 |
| 1962 | 46.2 | 49.1 |
| 1963 | 48.8 | 52.4 |
| 1964 | 60.7 | 82.2 |
| 1965 | 71.7 | 99.5 |
| 1966 | 87.3 | 115.4 |
| 1967 | 91.4 | 134.1 |
| 1968 | 88.8 | 119.4 |
| 1969 | 107.3 | 97.1 |
| 1970 | 146.2 | 92.2 |
| 1971 | 86.7 | 90.6 |
| 1972 | 178.8 | 101.2 |
| 1973 | 152.4 | 173.7 |
| 1974 | 227.9 | 226.0 |
| 1975 | 285.7 | 256.8 |
| 1976 | 332.6 | 258.4 |
| 1977 | 149.5 | 230.0 |



## 39 OTHER TRANSPORTATION EQUIP. (44)

### EMPLOYMENT PER UNIT OF OUTPUT

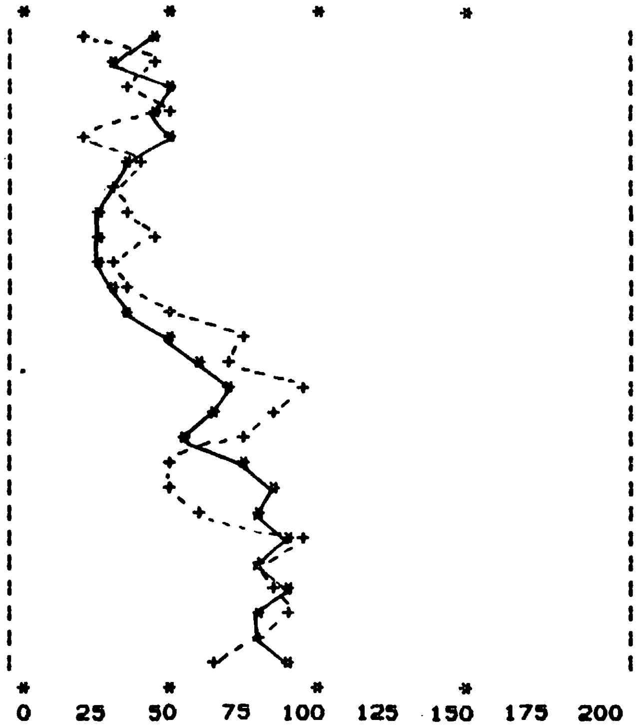
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 3.98 | 4.42 |
| 1953 | 3.96 | 4.66 |
| 1954 | 4.37 | 4.31 |
| 1955 | 3.74 | 4.45 |
| 1956 | 3.52 | 4.52 |
| 1957 | 3.25 | 4.70 |
| 1958 | 4.26 | 4.63 |
| 1959 | 5.39 | 4.81 |
| 1960 | 5.37 | 4.73 |
| 1961 | 6.94 | 4.27 |
| 1962 | 6.21 | 4.31 |
| 1963 | 5.48 | 4.05 |
| 1964 | 4.62 | 4.06 |
| 1965 | 4.14 | 3.86 |
| 1966 | 3.88 | 3.90 |
| 1967 | 4.00 | 3.78 |
| 1968 | 4.18 | 3.94 |
| 1969 | 3.80 | 4.15 |
| 1970 | 3.46 | 4.15 |
| 1971 | 3.36 | 3.90 |
| 1972 | 2.79 | 3.81 |
| 1973 | 2.71 | 3.44 |
| 1974 | 2.52 | 3.10 |
| 1975 | 2.65 | 2.79 |
| 1976 | 2.83 | 2.72 |
| 1977 | 2.66 | 2.64 |



1977 = 100%

### INVESTMENT

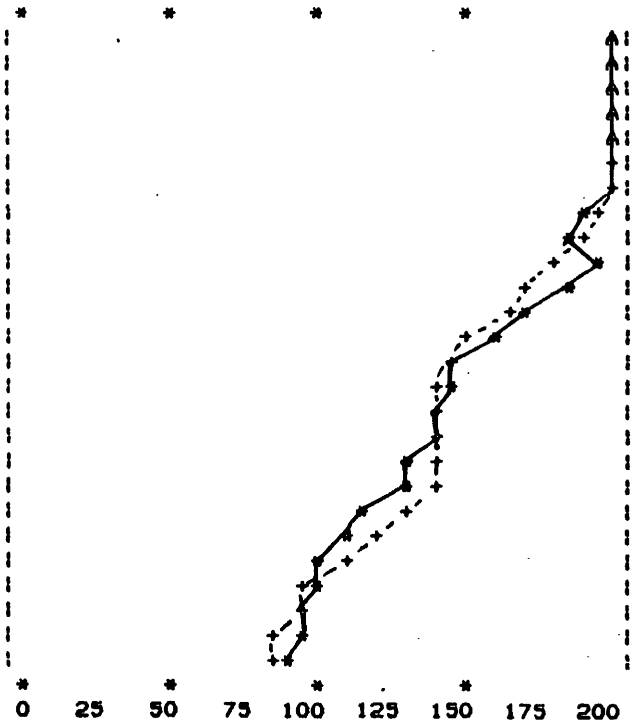
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 59.3 | 21.3 |
| 1953 | 39.7 | 59.0 |
| 1954 | 64.6 | 44.5 |
| 1955 | 59.8 | 63.5 |
| 1956 | 62.5 | 25.7 |
| 1957 | 44.9 | 49.2 |
| 1958 | 38.0 | 36.8 |
| 1959 | 30.7 | 42.3 |
| 1960 | 33.3 | 57.0 |
| 1961 | 27.9 | 36.3 |
| 1962 | 40.5 | 42.7 |
| 1963 | 47.4 | 63.0 |
| 1964 | 64.4 | 101.5 |
| 1965 | 80.3 | 93.7 |
| 1966 | 93.6 | 130.6 |
| 1967 | 84.1 | 110.8 |
| 1968 | 75.9 | 99.7 |
| 1969 | 100.0 | 63.3 |
| 1970 | 113.8 | 68.3 |
| 1971 | 105.8 | 81.5 |
| 1972 | 123.9 | 125.3 |
| 1973 | 104.0 | 108.5 |
| 1974 | 117.7 | 114.6 |
| 1975 | 109.5 | 119.3 |
| 1976 | 105.6 | 105.5 |
| 1977 | 122.9 | 86.2 |



40 INSTRUMENTS (45)

EMPLOYMENT PER UNIT OF OUTPUT

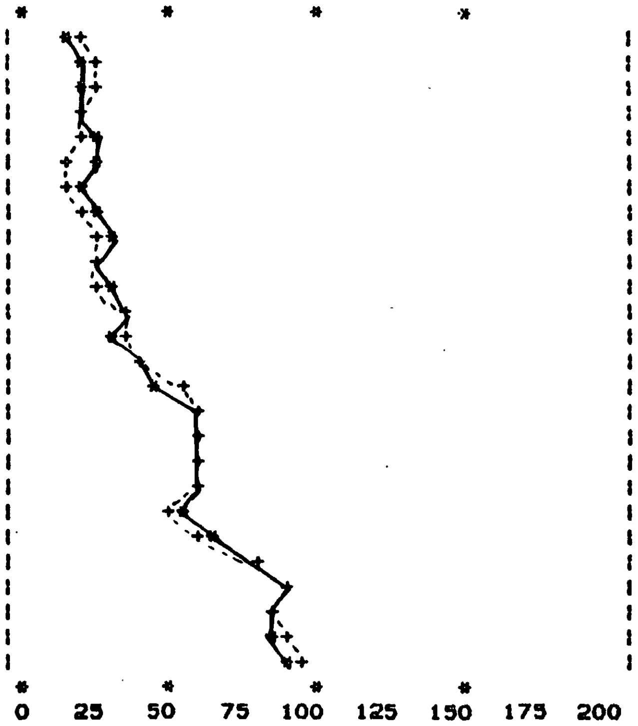
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 5.99 | 6.18 |
| 1953 | 6.23 | 6.36 |
| 1954 | 5.97 | 6.15 |
| 1955 | 5.81 | 5.90 |
| 1956 | 5.85 | 5.74 |
| 1957 | 5.80 | 5.55 |
| 1958 | 5.43 | 5.51 |
| 1959 | 5.23 | 5.28 |
| 1960 | 5.05 | 5.23 |
| 1961 | 5.31 | 4.96 |
| 1962 | 5.06 | 4.68 |
| 1963 | 4.68 | 4.47 |
| 1964 | 4.32 | 4.07 |
| 1965 | 4.00 | 3.94 |
| 1966 | 3.99 | 3.85 |
| 1967 | 3.83 | 3.79 |
| 1968 | 3.76 | 3.78 |
| 1969 | 3.57 | 3.77 |
| 1970 | 3.53 | 3.78 |
| 1971 | 3.18 | 3.48 |
| 1972 | 2.93 | 3.27 |
| 1973 | 2.71 | 2.98 |
| 1974 | 2.65 | 2.61 |
| 1975 | 2.63 | 2.53 |
| 1976 | 2.51 | 2.33 |
| 1977 | 2.47 | 2.25 |



1977 = 100%

INVESTMENT

| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 119.2 | 178.5 |
| 1953 | 149.3 | 235.0 |
| 1954 | 173.7 | 213.5 |
| 1955 | 170.9 | 182.6 |
| 1956 | 195.2 | 174.0 |
| 1957 | 202.9 | 133.9 |
| 1958 | 175.6 | 132.3 |
| 1959 | 224.8 | 164.6 |
| 1960 | 240.1 | 222.3 |
| 1961 | 227.5 | 217.6 |
| 1962 | 264.9 | 235.9 |
| 1963 | 318.0 | 290.5 |
| 1964 | 277.9 | 315.9 |
| 1965 | 372.5 | 373.5 |
| 1966 | 429.7 | 484.8 |
| 1967 | 544.5 | 545.4 |
| 1968 | 531.1 | 557.0 |
| 1969 | 566.6 | 548.0 |
| 1970 | 548.5 | 539.2 |
| 1971 | 498.0 | 477.4 |
| 1972 | 611.0 | 562.2 |
| 1973 | 728.6 | 755.2 |
| 1974 | 854.6 | 824.3 |
| 1975 | 773.7 | 775.0 |
| 1976 | 787.5 | 833.1 |
| 1977 | 853.2 | 868.0 |

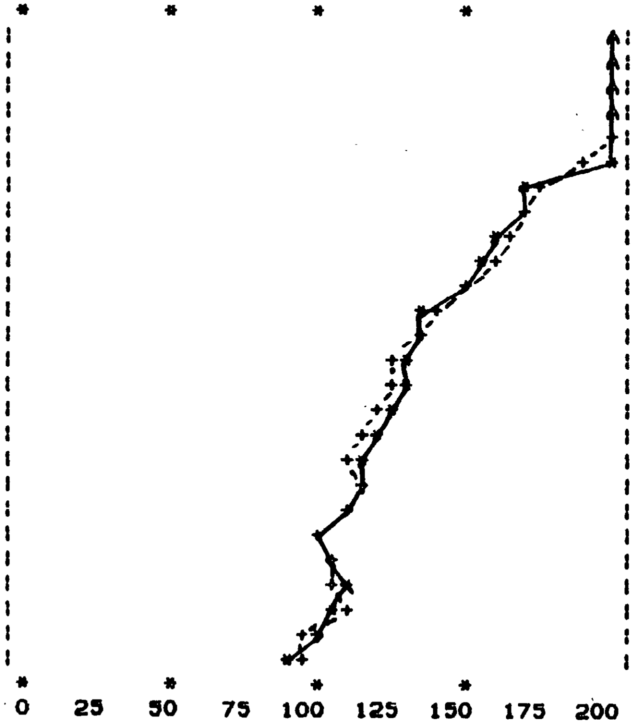


## 41 MISC. MFG. (46)

### EMPLOYMENT PER UNIT OF OUTPUT

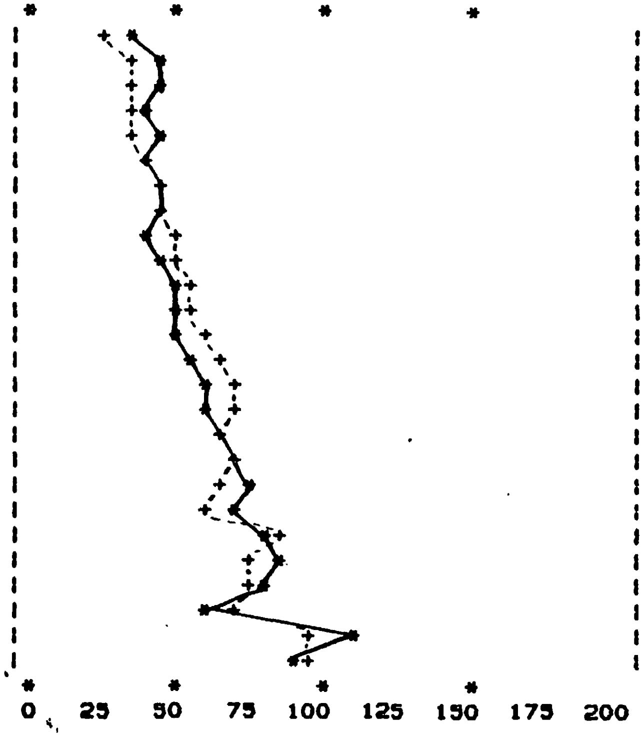
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 6.12 | 6.11 |
| 1953 | 5.85 | 5.71 |
| 1954 | 5.45 | 5.45 |
| 1955 | 5.29 | 5.26 |
| 1956 | 5.14 | 5.20 |
| 1957 | 5.13 | 4.96 |
| 1958 | 4.38 | 4.54 |
| 1959 | 4.38 | 4.45 |
| 1960 | 4.15 | 4.31 |
| 1961 | 3.94 | 4.19 |
| 1962 | 3.87 | 3.89 |
| 1963 | 3.51 | 3.63 |
| 1964 | 3.49 | 3.48 |
| 1965 | 3.40 | 3.26 |
| 1966 | 3.31 | 3.18 |
| 1967 | 3.16 | 3.05 |
| 1968 | 3.03 | 2.94 |
| 1969 | 2.90 | 2.82 |
| 1970 | 2.92 | 2.91 |
| 1971 | 2.82 | 2.82 |
| 1972 | 2.53 | 2.60 |
| 1973 | 2.64 | 2.69 |
| 1974 | 2.77 | 2.73 |
| 1975 | 2.71 | 2.81 |
| 1976 | 2.52 | 2.37 |
| 1977 | 2.33 | 2.36 |

1977 = 100%



### INVESTMENT

| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 152.0 | 123.4 |
| 1953 | 217.8 | 162.0 |
| 1954 | 205.0 | 170.2 |
| 1955 | 194.0 | 165.3 |
| 1956 | 205.0 | 172.6 |
| 1957 | 181.7 | 183.6 |
| 1958 | 208.9 | 201.7 |
| 1959 | 200.9 | 216.5 |
| 1960 | 194.2 | 235.9 |
| 1961 | 205.3 | 246.9 |
| 1962 | 242.0 | 258.8 |
| 1963 | 226.0 | 270.0 |
| 1964 | 245.1 | 272.9 |
| 1965 | 269.3 | 310.5 |
| 1966 | 277.0 | 325.4 |
| 1967 | 296.8 | 326.0 |
| 1968 | 300.5 | 318.9 |
| 1969 | 332.3 | 334.1 |
| 1970 | 349.6 | 309.0 |
| 1971 | 342.4 | 295.0 |
| 1972 | 396.0 | 409.5 |
| 1973 | 402.0 | 358.2 |
| 1974 | 381.8 | 362.3 |
| 1975 | 291.5 | 339.5 |
| 1976 | 526.1 | 465.7 |
| 1977 | 440.9 | 450.2 |

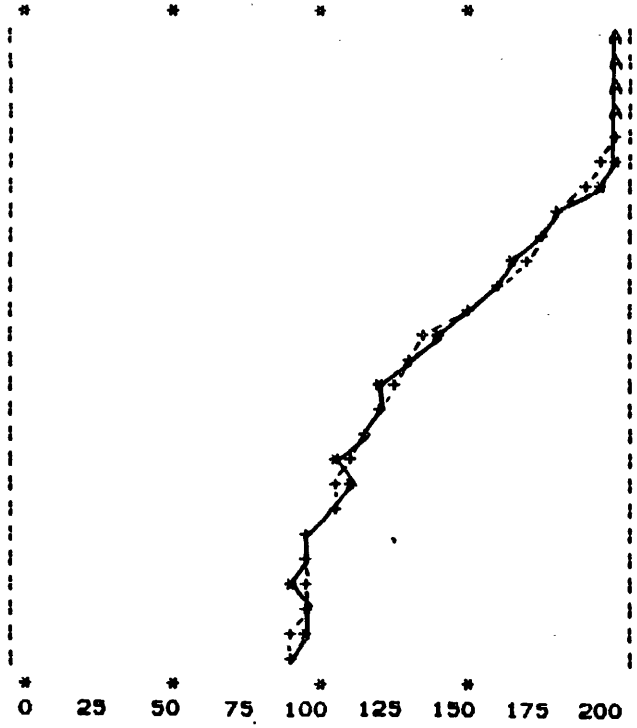


42 RAILROADS (47)

## EMPLOYMENT PER UNIT OF OUTPUT

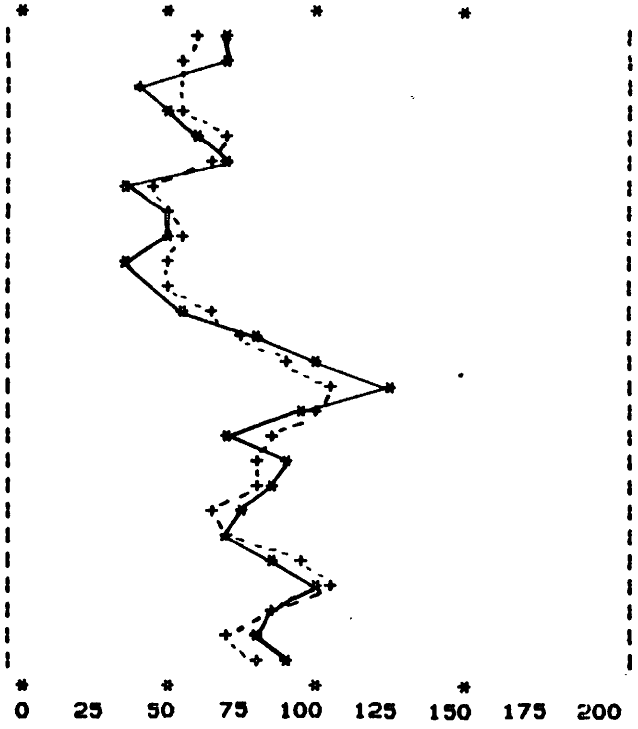
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 5.78 | 5.80 |
| 1953 | 5.75 | 5.87 |
| 1954 | 5.74 | 5.72 |
| 1955 | 5.39 | 5.37 |
| 1956 | 5.26 | 5.26 |
| 1957 | 5.26 | 5.09 |
| 1958 | 5.09 | 5.02 |
| 1959 | 4.71 | 4.72 |
| 1960 | 4.59 | 4.57 |
| 1961 | 4.30 | 4.39 |
| 1962 | 4.13 | 4.12 |
| 1963 | 3.87 | 3.89 |
| 1964 | 3.62 | 3.55 |
| 1965 | 3.32 | 3.34 |
| 1966 | 3.17 | 3.22 |
| 1967 | 3.07 | 3.12 |
| 1968 | 2.95 | 2.92 |
| 1969 | 2.76 | 2.80 |
| 1970 | 2.78 | 2.76 |
| 1971 | 2.71 | 2.69 |
| 1972 | 2.51 | 2.51 |
| 1973 | 2.40 | 2.41 |
| 1974 | 2.32 | 2.45 |
| 1975 | 2.46 | 2.51 |
| 1976 | 2.40 | 2.31 |
| 1977 | 2.35 | 2.31 |

1977 = 100%



## INVESTMENT

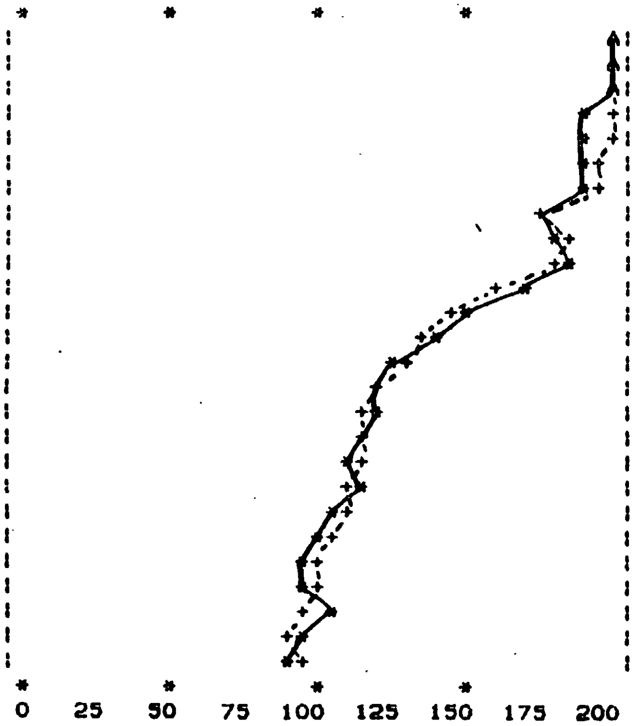
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 2825.0 | 2401.1 |
| 1953 | 2803.5 | 2195.9 |
| 1954 | 1516.6 | 1595.2 |
| 1955 | 1976.2 | 2192.0 |
| 1956 | 2265.2 | 2676.1 |
| 1957 | 2711.1 | 2525.6 |
| 1958 | 1279.5 | 1806.1 |
| 1959 | 1860.9 | 1979.6 |
| 1960 | 2004.8 | 2102.3 |
| 1961 | 1376.9 | 1944.4 |
| 1962 | 1846.7 | 1872.5 |
| 1963 | 2244.2 | 2496.2 |
| 1964 | 3106.4 | 3039.3 |
| 1965 | 4001.6 | 3567.3 |
| 1966 | 4920.4 | 4219.5 |
| 1967 | 3845.0 | 4064.4 |
| 1968 | 2708.5 | 3447.2 |
| 1969 | 3491.0 | 3135.5 |
| 1970 | 3406.5 | 3183.7 |
| 1971 | 2937.6 | 2650.1 |
| 1972 | 2831.2 | 2746.8 |
| 1973 | 3272.6 | 3807.0 |
| 1974 | 3953.2 | 4281.2 |
| 1975 | 3393.4 | 3472.4 |
| 1976 | 3267.7 | 2857.5 |
| 1977 | 3631.3 | 3218.1 |



43 AIR TRANSPORT (50)

## EMPLOYMENT PER UNIT OF OUTPUT

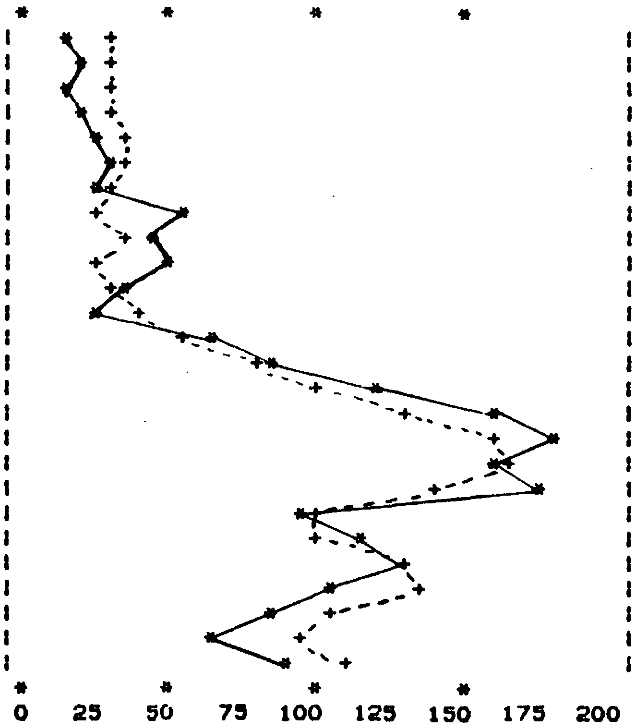
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 4.53 | 4.38 |
| 1953 | 4.25 | 4.18 |
| 1954 | 3.82 | 3.76 |
| 1955 | 3.49 | 3.65 |
| 1956 | 3.50 | 3.67 |
| 1957 | 3.44 | 3.52 |
| 1958 | 3.47 | 3.58 |
| 1959 | 3.15 | 3.22 |
| 1960 | 3.31 | 3.34 |
| 1961 | 3.36 | 3.33 |
| 1962 | 3.12 | 2.92 |
| 1963 | 2.77 | 2.67 |
| 1964 | 2.54 | 2.48 |
| 1965 | 2.26 | 2.33 |
| 1966 | 2.20 | 2.21 |
| 1967 | 2.15 | 2.06 |
| 1968 | 2.10 | 2.11 |
| 1969 | 2.02 | 2.06 |
| 1970 | 2.04 | 2.00 |
| 1971 | 1.94 | 1.97 |
| 1972 | 1.80 | 1.88 |
| 1973 | 1.74 | 1.80 |
| 1974 | 1.74 | 1.80 |
| 1975 | 1.85 | 1.73 |
| 1976 | 1.75 | 1.63 |
| 1977 | 1.64 | 1.73 |



1977 = 100%

## INVESTMENT

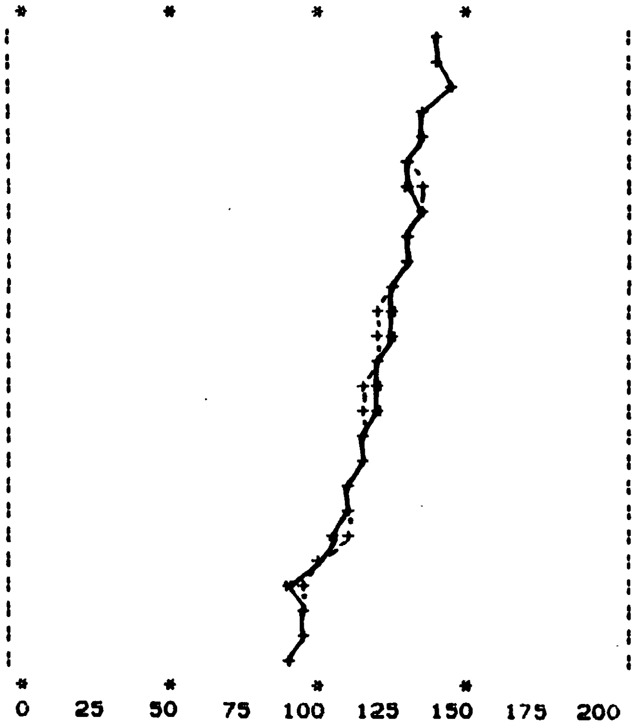
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 408.4 | 764.0 |
| 1953 | 424.6 | 751.6 |
| 1954 | 411.3 | 739.7 |
| 1955 | 497.2 | 756.5 |
| 1956 | 586.7 | 864.9 |
| 1957 | 701.3 | 910.1 |
| 1958 | 614.4 | 756.3 |
| 1959 | 1386.5 | 668.3 |
| 1960 | 1134.5 | 846.6 |
| 1961 | 1269.7 | 621.5 |
| 1962 | 899.3 | 755.4 |
| 1963 | 684.6 | 1047.9 |
| 1964 | 1773.5 | 1496.0 |
| 1965 | 2235.2 | 2162.6 |
| 1966 | 3269.3 | 2705.5 |
| 1967 | 4352.9 | 3474.7 |
| 1968 | 4864.9 | 4343.7 |
| 1969 | 4378.9 | 4486.0 |
| 1970 | 4673.8 | 3782.1 |
| 1971 | 2587.6 | 2717.4 |
| 1972 | 3074.9 | 2738.6 |
| 1973 | 3435.6 | 3508.8 |
| 1974 | 2806.4 | 3655.3 |
| 1975 | 2201.0 | 2753.7 |
| 1976 | 1684.5 | 2532.1 |
| 1977 | 2437.5 | 2955.1 |



## 44 TRUCKING AND OTHER TRANSPORT (48,49,

### EMPLOYMENT PER UNIT OF OUTPUT

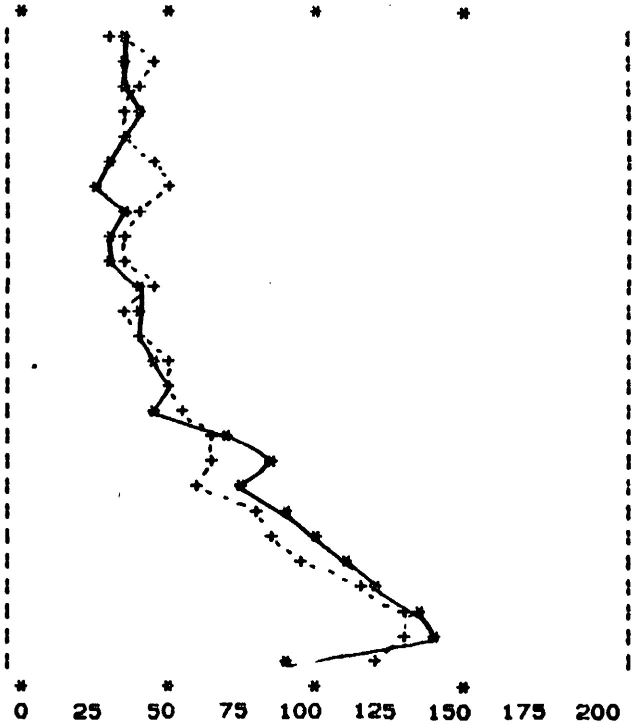
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 4.07 | 4.09 |
| 1953 | 4.11 | 4.13 |
| 1954 | 4.28 | 4.20 |
| 1955 | 3.96 | 3.95 |
| 1956 | 3.90 | 3.93 |
| 1957 | 3.81 | 3.85 |
| 1958 | 3.85 | 4.01 |
| 1959 | 3.93 | 3.93 |
| 1960 | 3.79 | 3.87 |
| 1961 | 3.74 | 3.75 |
| 1962 | 3.64 | 3.68 |
| 1963 | 3.69 | 3.59 |
| 1964 | 3.67 | 3.53 |
| 1965 | 3.58 | 3.47 |
| 1966 | 3.51 | 3.43 |
| 1967 | 3.58 | 3.38 |
| 1968 | 3.42 | 3.34 |
| 1969 | 3.30 | 3.32 |
| 1970 | 3.28 | 3.29 |
| 1971 | 3.16 | 3.26 |
| 1972 | 3.02 | 3.16 |
| 1973 | 2.88 | 2.99 |
| 1974 | 2.69 | 2.79 |
| 1975 | 2.80 | 2.77 |
| 1976 | 2.74 | 2.73 |
| 1977 | 2.66 | 2.62 |



1977 = 100%

### INVESTMENT

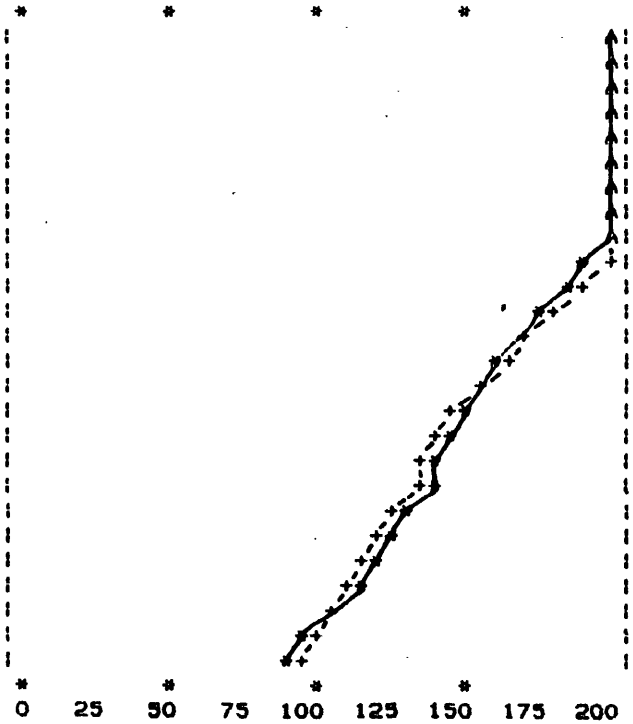
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 1841.1 | 1669.5 |
| 1953 | 1998.9 | 2398.7 |
| 1954 | 1822.5 | 2134.3 |
| 1955 | 2110.7 | 1830.1 |
| 1956 | 1781.6 | 1900.7 |
| 1957 | 1723.4 | 2492.5 |
| 1958 | 1335.4 | 2799.4 |
| 1959 | 1799.5 | 2043.7 |
| 1960 | 1729.9 | 1751.3 |
| 1961 | 1658.4 | 1898.3 |
| 1962 | 2225.9 | 2364.3 |
| 1963 | 2094.9 | 2039.1 |
| 1964 | 2088.0 | 2224.5 |
| 1965 | 2598.4 | 2745.0 |
| 1966 | 2744.8 | 2839.2 |
| 1967 | 2613.1 | 2985.4 |
| 1968 | 3875.7 | 3673.8 |
| 1969 | 4945.5 | 3608.6 |
| 1970 | 4088.2 | 3397.0 |
| 1971 | 4975.2 | 4598.1 |
| 1972 | 5747.5 | 4909.4 |
| 1973 | 6353.5 | 5505.5 |
| 1974 | 6814.0 | 6430.5 |
| 1975 | 7764.9 | 7372.3 |
| 1976 | 8028.7 | 7449.4 |
| 1977 | 5187.3 | 6886.2 |



45 COMMUNICATIONS SERVICES (53)

## EMPLOYMENT PER UNIT OF OUTPUT

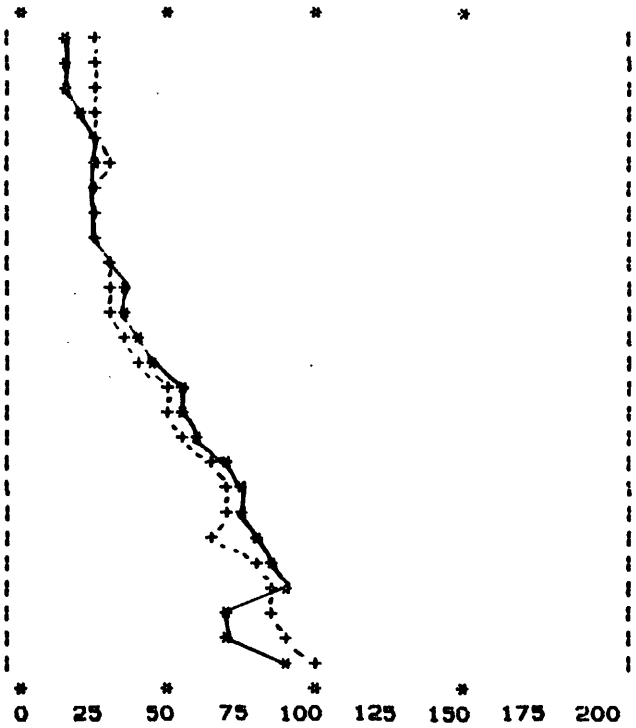
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 7.09 | 7.10 |
| 1953 | 6.64 | 6.68 |
| 1954 | 6.44 | 6.39 |
| 1955 | 6.16 | 5.90 |
| 1956 | 6.09 | 5.83 |
| 1957 | 5.61 | 5.50 |
| 1958 | 5.11 | 5.26 |
| 1959 | 4.66 | 4.96 |
| 1960 | 4.56 | 4.77 |
| 1961 | 4.15 | 4.40 |
| 1962 | 4.00 | 4.12 |
| 1963 | 3.80 | 3.92 |
| 1964 | 3.63 | 3.71 |
| 1965 | 3.51 | 3.54 |
| 1966 | 3.39 | 3.35 |
| 1967 | 3.22 | 3.19 |
| 1968 | 3.16 | 3.02 |
| 1969 | 3.02 | 2.94 |
| 1970 | 3.04 | 2.86 |
| 1971 | 2.85 | 2.64 |
| 1972 | 2.66 | 2.57 |
| 1973 | 2.59 | 2.49 |
| 1974 | 2.44 | 2.36 |
| 1975 | 2.23 | 2.25 |
| 1976 | 2.06 | 2.19 |
| 1977 | 1.96 | 2.08 |



1977 = 100%

## INVESTMENT

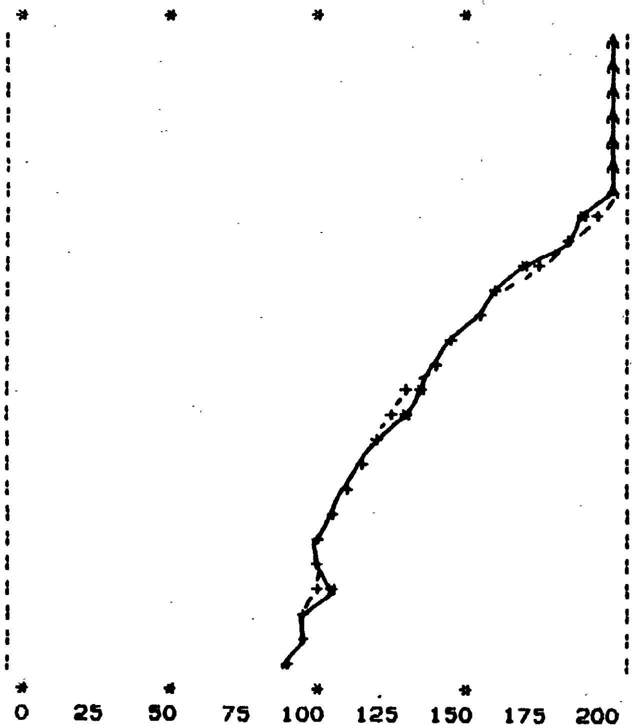
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 1259.7 | 2031.5 |
| 1953 | 1461.9 | 2302.7 |
| 1954 | 1410.9 | 2074.9 |
| 1955 | 1769.0 | 2165.8 |
| 1956 | 2045.6 | 2182.5 |
| 1957 | 2446.1 | 2537.1 |
| 1958 | 2088.3 | 2365.8 |
| 1959 | 2077.1 | 2373.9 |
| 1960 | 2465.9 | 2417.1 |
| 1961 | 2808.2 | 2674.4 |
| 1962 | 3371.5 | 2776.5 |
| 1963 | 3436.3 | 2955.7 |
| 1964 | 3662.6 | 3351.6 |
| 1965 | 4366.7 | 3799.5 |
| 1966 | 4972.7 | 4556.5 |
| 1967 | 5104.1 | 4945.5 |
| 1968 | 5867.1 | 5021.2 |
| 1969 | 6777.6 | 5996.2 |
| 1970 | 7308.7 | 6750.1 |
| 1971 | 7336.2 | 6570.7 |
| 1972 | 7583.3 | 6285.0 |
| 1973 | 8232.2 | 7625.0 |
| 1974 | 8448.6 | 8298.1 |
| 1975 | 6641.8 | 8295.4 |
| 1976 | 6808.2 | 8577.9 |
| 1977 | 8826.4 | 9647.0 |



## 46 ELECTRIC UTILITIES (54)

### EMPLOYMENT PER UNIT OF OUTPUT

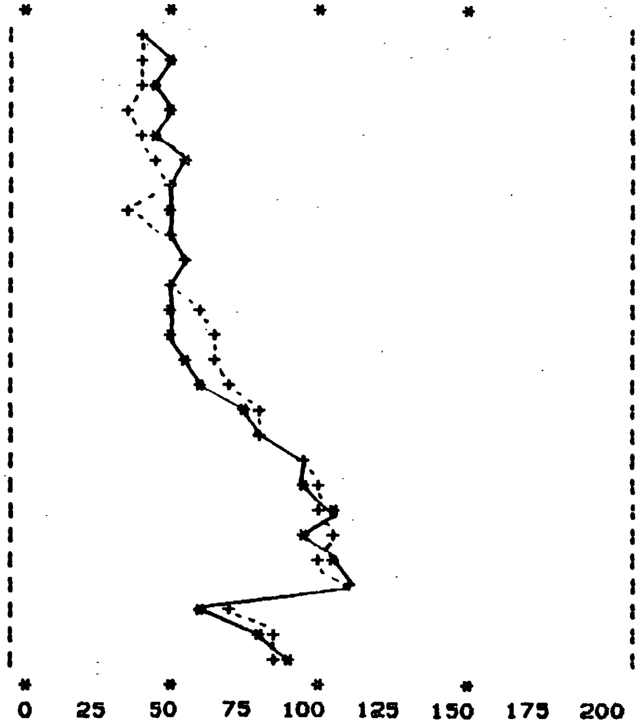
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 2.98 | 2.97 |
| 1953 | 2.80 | 2.80 |
| 1954 | 2.67 | 2.65 |
| 1955 | 2.51 | 2.48 |
| 1956 | 2.37 | 2.36 |
| 1957 | 2.22 | 2.28 |
| 1958 | 2.16 | 2.18 |
| 1959 | 1.99 | 2.01 |
| 1960 | 1.89 | 1.92 |
| 1961 | 1.79 | 1.80 |
| 1962 | 1.66 | 1.67 |
| 1963 | 1.58 | 1.58 |
| 1964 | 1.49 | 1.49 |
| 1965 | 1.47 | 1.43 |
| 1966 | 1.38 | 1.35 |
| 1967 | 1.33 | 1.29 |
| 1968 | 1.23 | 1.21 |
| 1969 | 1.18 | 1.17 |
| 1970 | 1.13 | 1.15 |
| 1971 | 1.08 | 1.10 |
| 1972 | 1.04 | 1.05 |
| 1973 | 1.00 | 1.01 |
| 1974 | 1.05 | 1.04 |
| 1975 | 0.97 | 0.97 |
| 1976 | 0.95 | 0.95 |
| 1977 | 0.93 | 0.92 |



1977 = 100%

### INVESTMENT

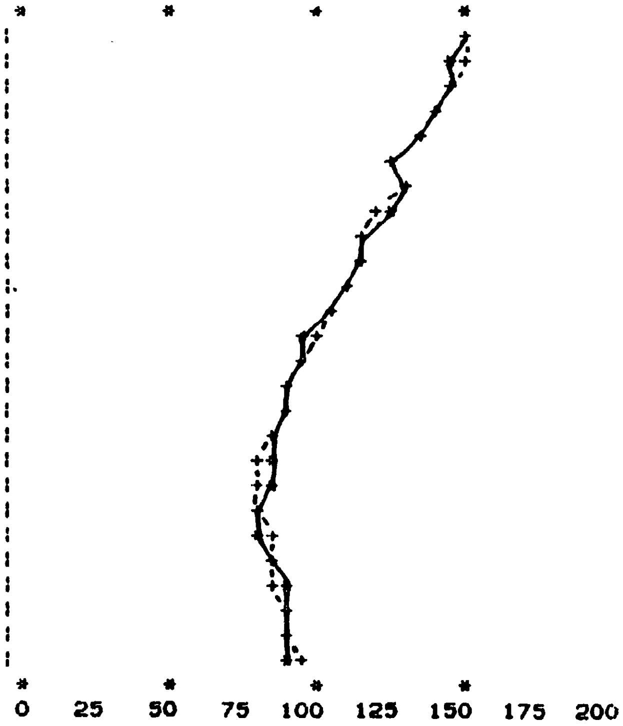
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 2038.7 | 1844.0 |
| 1953 | 2447.4 | 1801.6 |
| 1954 | 2247.8 | 1846.5 |
| 1955 | 2416.7 | 1786.5 |
| 1956 | 2180.0 | 1918.6 |
| 1957 | 2725.4 | 2252.5 |
| 1958 | 2461.2 | 2348.6 |
| 1959 | 2471.0 | 1752.4 |
| 1960 | 2427.9 | 2339.7 |
| 1961 | 2598.8 | 2630.3 |
| 1962 | 2548.7 | 2520.5 |
| 1963 | 2490.9 | 2932.4 |
| 1964 | 2524.9 | 3112.3 |
| 1965 | 2626.0 | 3277.1 |
| 1966 | 2883.6 | 3443.2 |
| 1967 | 3802.5 | 3901.7 |
| 1968 | 3980.4 | 4056.3 |
| 1969 | 4625.9 | 4807.2 |
| 1970 | 4644.8 | 5088.9 |
| 1971 | 5154.9 | 4976.1 |
| 1972 | 4846.1 | 5223.7 |
| 1973 | 5306.9 | 5102.0 |
| 1974 | 5412.5 | 5468.7 |
| 1975 | 2900.6 | 3593.2 |
| 1976 | 4053.0 | 4181.9 |
| 1977 | 4566.9 | 4177.7 |



## 47 GAS, WATER & SANITATION (55, 56)

### EMPLOYMENT PER UNIT OF OUTPUT

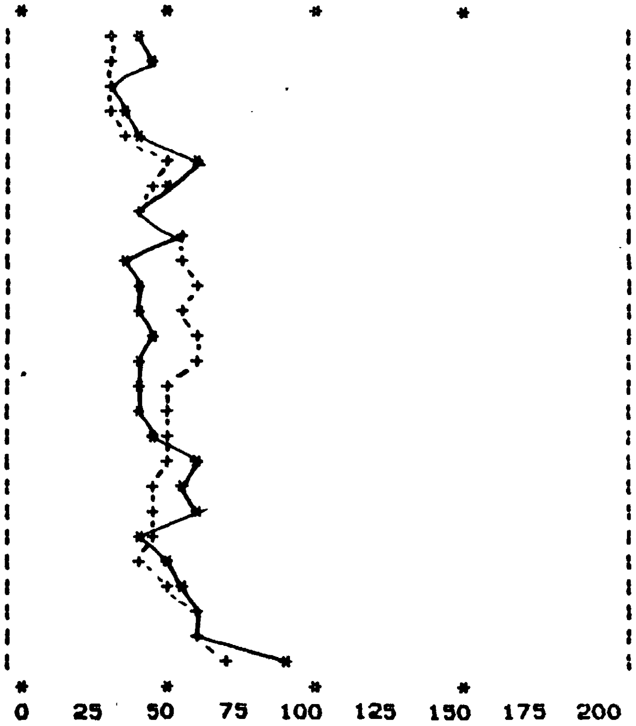
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 0.69 | 0.68 |
| 1953 | 0.66 | 0.67 |
| 1954 | 0.67 | 0.66 |
| 1955 | 0.63 | 0.63 |
| 1956 | 0.62 | 0.61 |
| 1957 | 0.55 | 0.57 |
| 1958 | 0.59 | 0.59 |
| 1959 | 0.56 | 0.55 |
| 1960 | 0.53 | 0.53 |
| 1961 | 0.52 | 0.51 |
| 1962 | 0.49 | 0.49 |
| 1963 | 0.46 | 0.47 |
| 1964 | 0.44 | 0.44 |
| 1965 | 0.43 | 0.43 |
| 1966 | 0.40 | 0.41 |
| 1967 | 0.40 | 0.40 |
| 1968 | 0.38 | 0.37 |
| 1969 | 0.37 | 0.36 |
| 1970 | 0.37 | 0.36 |
| 1971 | 0.36 | 0.37 |
| 1972 | 0.36 | 0.37 |
| 1973 | 0.38 | 0.38 |
| 1974 | 0.40 | 0.39 |
| 1975 | 0.41 | 0.41 |
| 1976 | 0.41 | 0.41 |
| 1977 | 0.41 | 0.41 |



1977 = 100%

### INVESTMENT

| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 729.9 | 537.3 |
| 1953 | 854.2 | 523.3 |
| 1954 | 527.8 | 506.0 |
| 1955 | 579.1 | 505.6 |
| 1956 | 753.9 | 669.0 |
| 1957 | 1147.4 | 936.9 |
| 1958 | 907.4 | 841.5 |
| 1959 | 676.4 | 720.2 |
| 1960 | 1032.7 | 1012.9 |
| 1961 | 617.8 | 1011.6 |
| 1962 | 706.4 | 1061.6 |
| 1963 | 723.3 | 1055.2 |
| 1964 | 815.4 | 1096.2 |
| 1965 | 736.7 | 1095.2 |
| 1966 | 695.7 | 897.2 |
| 1967 | 742.9 | 891.3 |
| 1968 | 787.3 | 911.1 |
| 1969 | 1126.3 | 897.2 |
| 1970 | 1000.3 | 836.6 |
| 1971 | 1133.9 | 856.5 |
| 1972 | 717.1 | 818.4 |
| 1973 | 955.5 | 759.7 |
| 1974 | 990.3 | 872.4 |
| 1975 | 1123.8 | 1108.3 |
| 1976 | 1101.2 | 1130.4 |
| 1977 | 1713.9 | 1345.4 |

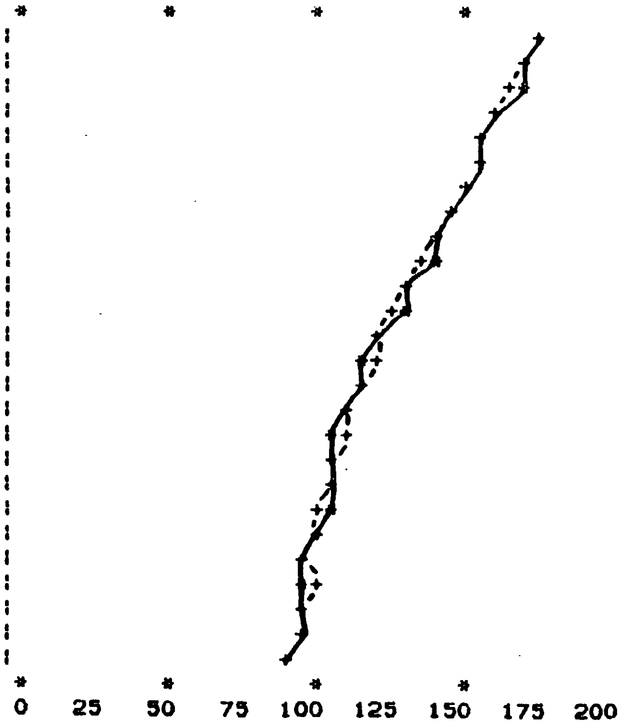


48 WHOLESALE & RETAIL TRADE (57, 58)

## EMPLOYMENT PER UNIT OF OUTPUT

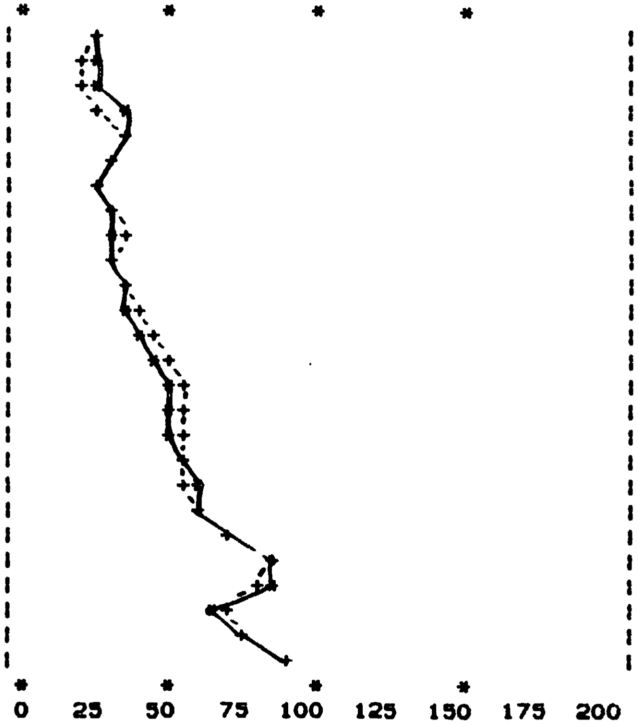
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 11.20 | 11.26 |
| 1953 | 10.99 | 10.99 |
| 1954 | 10.80 | 10.63 |
| 1955 | 10.14 | 10.20 |
| 1956 | 9.88 | 10.02 |
| 1957 | 9.82 | 9.83 |
| 1958 | 9.74 | 9.71 |
| 1959 | 9.23 | 9.21 |
| 1960 | 9.05 | 9.04 |
| 1961 | 8.85 | 8.79 |
| 1962 | 8.42 | 8.46 |
| 1963 | 8.18 | 8.08 |
| 1964 | 7.73 | 7.75 |
| 1965 | 7.50 | 7.55 |
| 1966 | 7.35 | 7.32 |
| 1967 | 7.09 | 7.17 |
| 1968 | 6.67 | 6.88 |
| 1969 | 6.76 | 6.72 |
| 1970 | 6.74 | 6.59 |
| 1971 | 6.56 | 6.43 |
| 1972 | 6.24 | 6.23 |
| 1973 | 5.98 | 6.10 |
| 1974 | 6.12 | 6.21 |
| 1975 | 6.11 | 6.14 |
| 1976 | 5.97 | 5.90 |
| 1977 | 5.81 | 5.79 |

1977 = 100%



## INVESTMENT

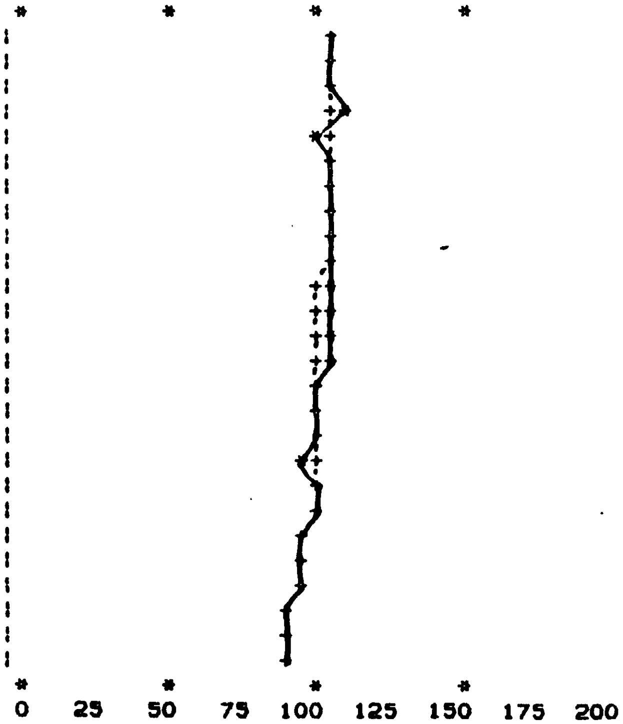
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 3468.5 | 3456.1 |
| 1953 | 4200.0 | 3387.3 |
| 1954 | 4136.4 | 3385.4 |
| 1955 | 5143.6 | 4186.0 |
| 1956 | 5173.4 | 5321.6 |
| 1957 | 4384.4 | 4866.6 |
| 1958 | 4023.8 | 3811.1 |
| 1959 | 4959.7 | 4575.4 |
| 1960 | 5025.8 | 5292.0 |
| 1961 | 4899.3 | 4935.9 |
| 1962 | 5342.2 | 5321.0 |
| 1963 | 5683.1 | 6492.2 |
| 1964 | 6339.2 | 6978.0 |
| 1965 | 7570.3 | 7872.4 |
| 1966 | 8185.3 | 8853.1 |
| 1967 | 7736.1 | 8676.2 |
| 1968 | 8334.7 | 8875.6 |
| 1969 | 8907.5 | 9145.9 |
| 1970 | 9565.1 | 8756.4 |
| 1971 | 9658.1 | 9470.7 |
| 1972 | 11431.9 | 11705.1 |
| 1973 | 14344.1 | 13866.6 |
| 1974 | 14203.3 | 13307.9 |
| 1975 | 11024.0 | 11579.5 |
| 1976 | 12284.3 | 12298.3 |
| 1977 | 15083.5 | 14692.8 |



## 49 FINANCE & INSURANCE (60)

### EMPLOYMENT PER UNIT OF OUTPUT

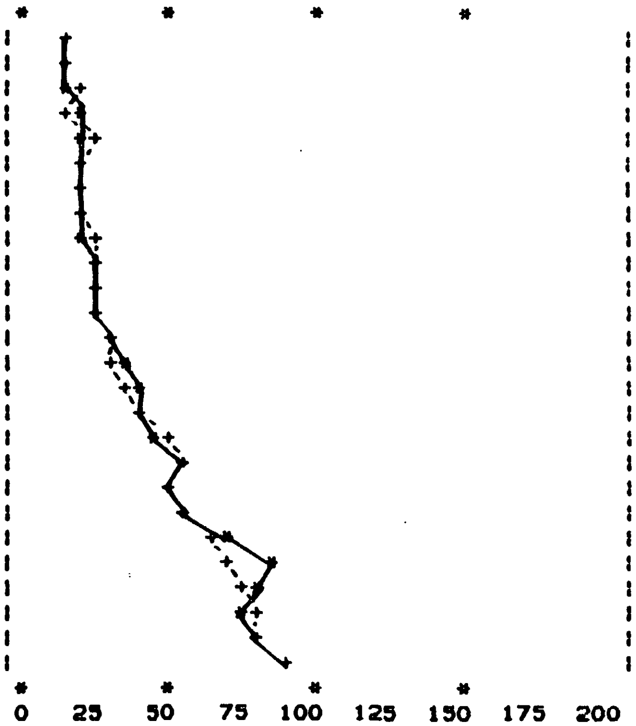
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 3.64 | 3.71 |
| 1953 | 3.71 | 3.72 |
| 1954 | 3.70 | 3.68 |
| 1955 | 3.76 | 3.67 |
| 1956 | 3.56 | 3.65 |
| 1957 | 3.60 | 3.62 |
| 1958 | 3.65 | 3.66 |
| 1959 | 3.64 | 3.62 |
| 1960 | 3.62 | 3.62 |
| 1961 | 3.60 | 3.60 |
| 1962 | 3.57 | 3.56 |
| 1963 | 3.57 | 3.53 |
| 1964 | 3.58 | 3.52 |
| 1965 | 3.57 | 3.49 |
| 1966 | 3.54 | 3.48 |
| 1967 | 3.51 | 3.47 |
| 1968 | 3.44 | 3.44 |
| 1969 | 3.35 | 3.43 |
| 1970 | 3.41 | 3.42 |
| 1971 | 3.40 | 3.42 |
| 1972 | 3.23 | 3.36 |
| 1973 | 3.34 | 3.32 |
| 1974 | 3.22 | 3.21 |
| 1975 | 3.18 | 3.19 |
| 1976 | 3.18 | 3.17 |
| 1977 | 3.17 | 3.15 |



1977 = 100%

### INVESTMENT

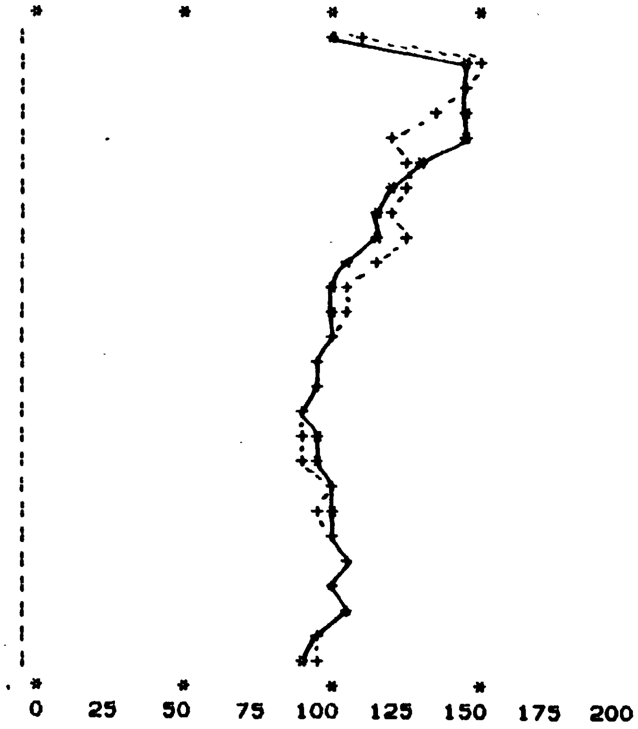
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 472.0 | 540.9 |
| 1953 | 531.6 | 569.5 |
| 1954 | 524.2 | 672.9 |
| 1955 | 702.9 | 634.9 |
| 1956 | 693.9 | 903.2 |
| 1957 | 733.8 | 859.4 |
| 1958 | 701.9 | 757.8 |
| 1959 | 781.8 | 813.0 |
| 1960 | 884.9 | 961.9 |
| 1961 | 907.9 | 985.7 |
| 1962 | 1017.1 | 1016.0 |
| 1963 | 1045.7 | 1077.3 |
| 1964 | 1160.2 | 1162.6 |
| 1965 | 1425.5 | 1268.1 |
| 1966 | 1684.0 | 1422.5 |
| 1967 | 1606.8 | 1744.0 |
| 1968 | 1967.0 | 2075.6 |
| 1969 | 2264.7 | 2398.2 |
| 1970 | 2188.0 | 2150.6 |
| 1971 | 2426.7 | 2224.4 |
| 1972 | 2930.1 | 2745.8 |
| 1973 | 3558.4 | 3011.1 |
| 1974 | 3533.9 | 3256.1 |
| 1975 | 3206.1 | 3540.3 |
| 1976 | 3369.6 | 3512.4 |
| 1977 | 3944.7 | 3959.3 |



50 REAL ESTATE (61)

## EMPLOYMENT PER UNIT OF OUTPUT

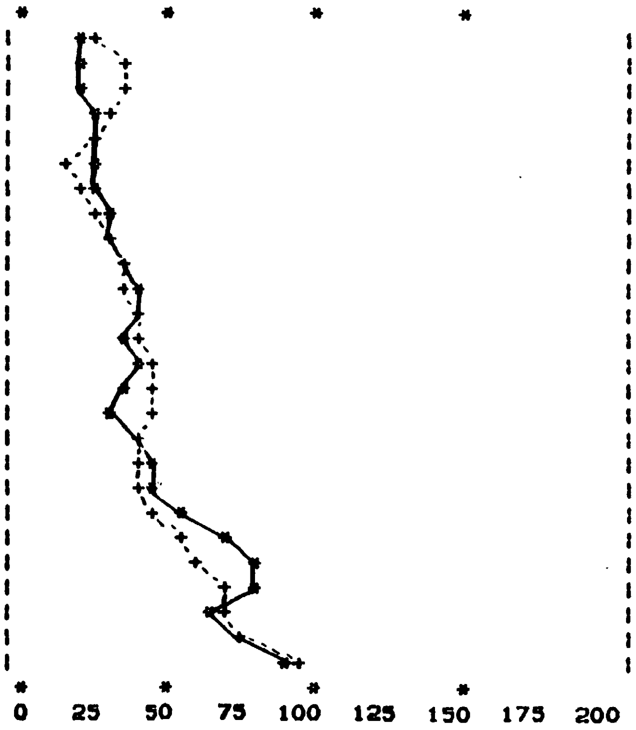
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 0.91 | 1.00 |
| 1953 | 1.35 | 1.41 |
| 1954 | 1.34 | 1.35 |
| 1955 | 1.35 | 1.25 |
| 1956 | 1.33 | 1.09 |
| 1957 | 1.21 | 1.15 |
| 1958 | 1.11 | 1.13 |
| 1959 | 1.05 | 1.10 |
| 1960 | 1.04 | 1.15 |
| 1961 | 0.98 | 1.05 |
| 1962 | 0.93 | 0.97 |
| 1963 | 0.94 | 0.96 |
| 1964 | 0.90 | 0.92 |
| 1965 | 0.87 | 0.87 |
| 1966 | 0.85 | 0.86 |
| 1967 | 0.84 | 0.84 |
| 1968 | 0.85 | 0.83 |
| 1969 | 0.88 | 0.84 |
| 1970 | 0.92 | 0.91 |
| 1971 | 0.90 | 0.86 |
| 1972 | 0.93 | 0.93 |
| 1973 | 0.96 | 0.96 |
| 1974 | 0.92 | 0.90 |
| 1975 | 0.96 | 0.95 |
| 1976 | 0.89 | 0.88 |
| 1977 | 0.84 | 0.88 |



1977 = 100%

## INVESTMENT

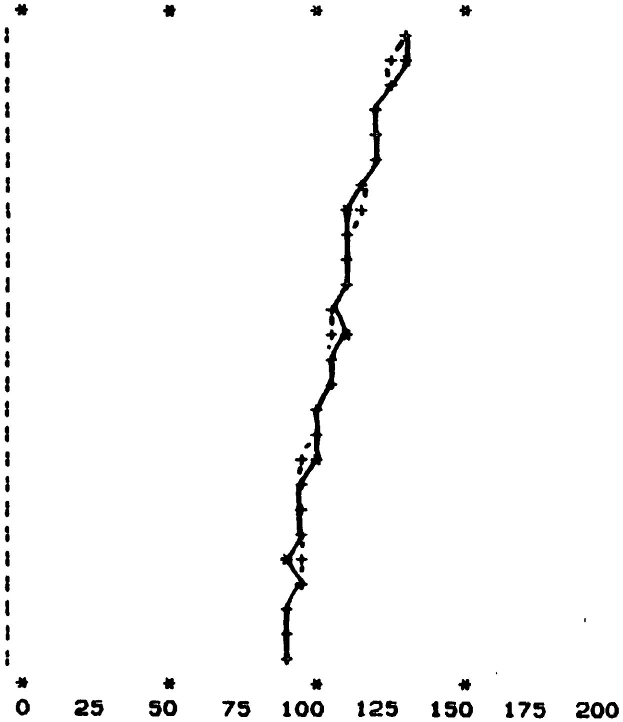
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 937.2 | 1360.2 |
| 1953 | 1054.3 | 1718.8 |
| 1954 | 1038.8 | 1705.7 |
| 1955 | 1308.3 | 1585.7 |
| 1956 | 1187.0 | 1256.1 |
| 1957 | 1271.8 | 801.7 |
| 1958 | 1277.7 | 1041.5 |
| 1959 | 1510.3 | 1352.3 |
| 1960 | 1654.2 | 1494.7 |
| 1961 | 1732.2 | 1714.6 |
| 1962 | 2030.2 | 1900.9 |
| 1963 | 2074.0 | 1983.5 |
| 1964 | 1890.9 | 2118.6 |
| 1965 | 1973.5 | 2342.3 |
| 1966 | 1963.4 | 2393.0 |
| 1967 | 1531.6 | 2403.0 |
| 1968 | 1983.1 | 2234.7 |
| 1969 | 2383.3 | 2089.3 |
| 1970 | 2422.5 | 2048.1 |
| 1971 | 3049.0 | 2465.5 |
| 1972 | 3779.0 | 2890.8 |
| 1973 | 4492.1 | 3351.2 |
| 1974 | 4338.1 | 3818.4 |
| 1975 | 3519.2 | 3942.5 |
| 1976 | 3993.7 | 4146.7 |
| 1977 | 5008.1 | 5243.5 |



51 HOTELS & REPAIRS MINUS AUTO (63)

EMPLOYMENT PER UNIT OF OUTPUT

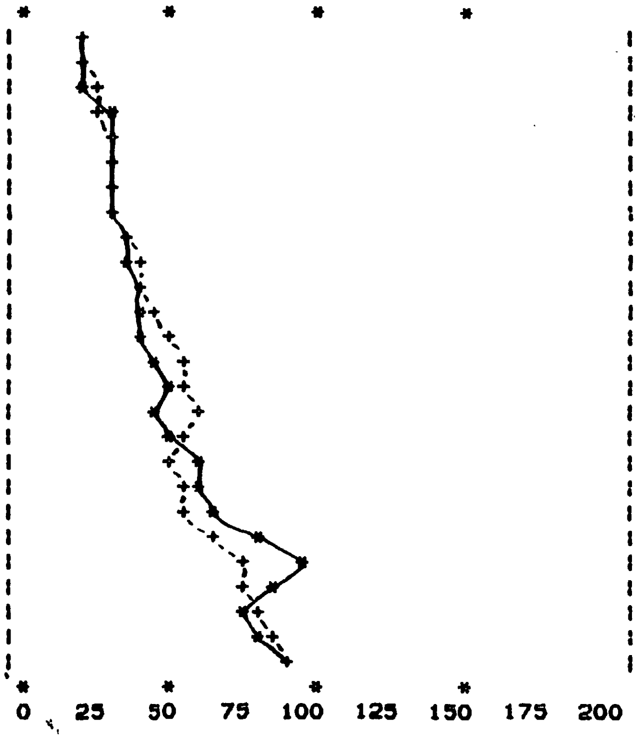
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 10.07 | 9.91 |
| 1953 | 9.92 | 9.65 |
| 1954 | 9.57 | 9.61 |
| 1955 | 9.30 | 9.36 |
| 1956 | 9.18 | 9.22 |
| 1957 | 9.12 | 9.11 |
| 1958 | 8.76 | 8.94 |
| 1959 | 8.47 | 8.84 |
| 1960 | 8.54 | 8.67 |
| 1961 | 8.47 | 8.62 |
| 1962 | 8.34 | 8.34 |
| 1963 | 8.18 | 8.21 |
| 1964 | 8.32 | 8.11 |
| 1965 | 8.17 | 7.97 |
| 1966 | 8.12 | 7.91 |
| 1967 | 7.52 | 7.76 |
| 1968 | 7.63 | 7.57 |
| 1969 | 7.72 | 7.48 |
| 1970 | 7.41 | 7.44 |
| 1971 | 7.50 | 7.45 |
| 1972 | 7.18 | 7.36 |
| 1973 | 7.09 | 7.25 |
| 1974 | 7.19 | 7.21 |
| 1975 | 6.98 | 6.95 |
| 1976 | 6.97 | 6.93 |
| 1977 | 7.02 | 6.94 |



1977 = 100%

INVESTMENT

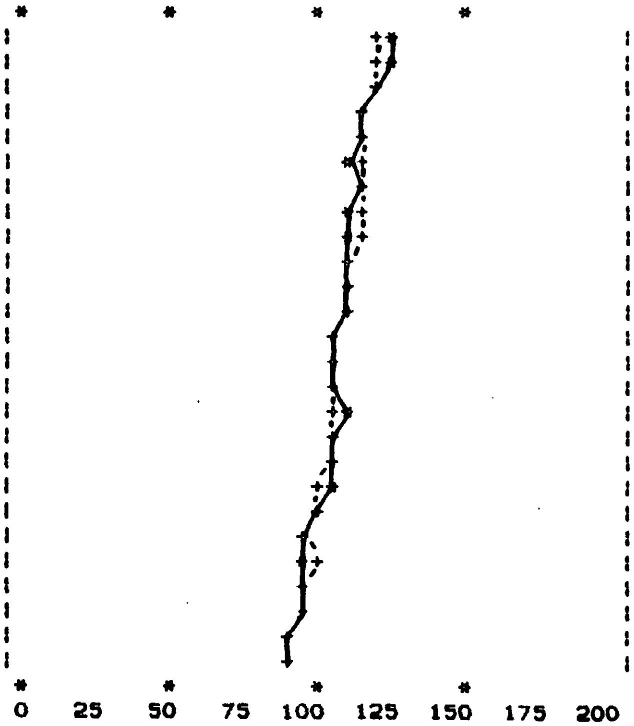
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 622.8 | 573.0 |
| 1953 | 700.2 | 658.1 |
| 1954 | 690.6 | 740.1 |
| 1955 | 996.2 | 822.5 |
| 1956 | 922.0 | 958.8 |
| 1957 | 973.9 | 1033.9 |
| 1958 | 923.8 | 1027.5 |
| 1959 | 1045.7 | 1073.2 |
| 1960 | 1163.5 | 1233.0 |
| 1961 | 1188.8 | 1316.5 |
| 1962 | 1343.4 | 1457.0 |
| 1963 | 1379.1 | 1567.3 |
| 1964 | 1369.1 | 1653.3 |
| 1965 | 1546.5 | 1872.3 |
| 1966 | 1696.6 | 2006.8 |
| 1967 | 1483.4 | 2099.6 |
| 1968 | 1797.5 | 1942.0 |
| 1969 | 2065.4 | 1812.7 |
| 1970 | 2074.1 | 1884.3 |
| 1971 | 2257.0 | 1876.4 |
| 1972 | 2815.6 | 2260.3 |
| 1973 | 3308.9 | 2685.1 |
| 1974 | 3084.1 | 2672.0 |
| 1975 | 2688.9 | 2812.2 |
| 1976 | 2813.8 | 2970.4 |
| 1977 | 3248.3 | 3191.0 |



52 BUSINESS SERVICES (64)

EMPLOYMENT PER UNIT OF OUTPUT

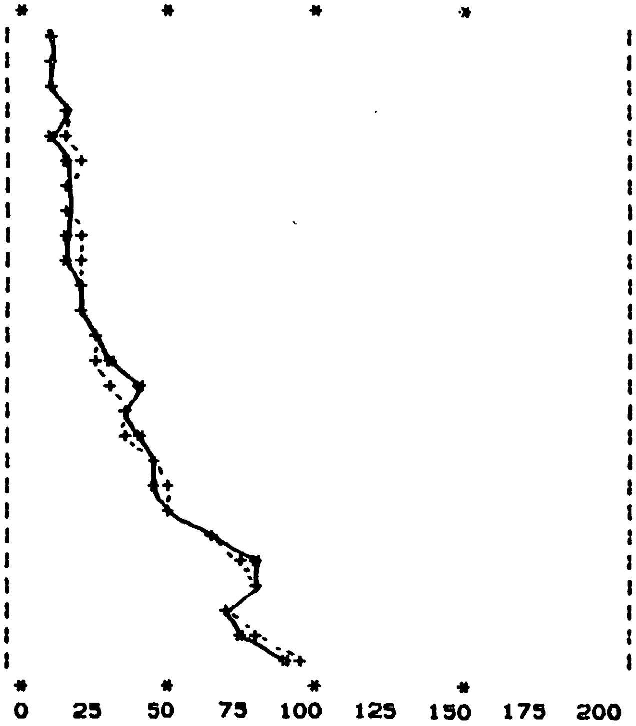
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 3.59 | 3.49 |
| 1953 | 3.62 | 3.52 |
| 1954 | 3.46 | 3.43 |
| 1955 | 3.37 | 3.40 |
| 1956 | 3.35 | 3.37 |
| 1957 | 3.25 | 3.36 |
| 1958 | 3.29 | 3.37 |
| 1959 | 3.26 | 3.29 |
| 1960 | 3.17 | 3.29 |
| 1961 | 3.16 | 3.20 |
| 1962 | 3.19 | 3.18 |
| 1963 | 3.13 | 3.13 |
| 1964 | 3.11 | 3.10 |
| 1965 | 3.05 | 3.08 |
| 1966 | 2.98 | 3.03 |
| 1967 | 3.24 | 3.04 |
| 1968 | 3.10 | 2.98 |
| 1969 | 3.09 | 2.98 |
| 1970 | 2.99 | 2.95 |
| 1971 | 2.90 | 2.90 |
| 1972 | 2.69 | 2.82 |
| 1973 | 2.76 | 2.84 |
| 1974 | 2.68 | 2.70 |
| 1975 | 2.79 | 2.77 |
| 1976 | 2.62 | 2.60 |
| 1977 | 2.64 | 2.63 |



1977 = 100%

INVESTMENT

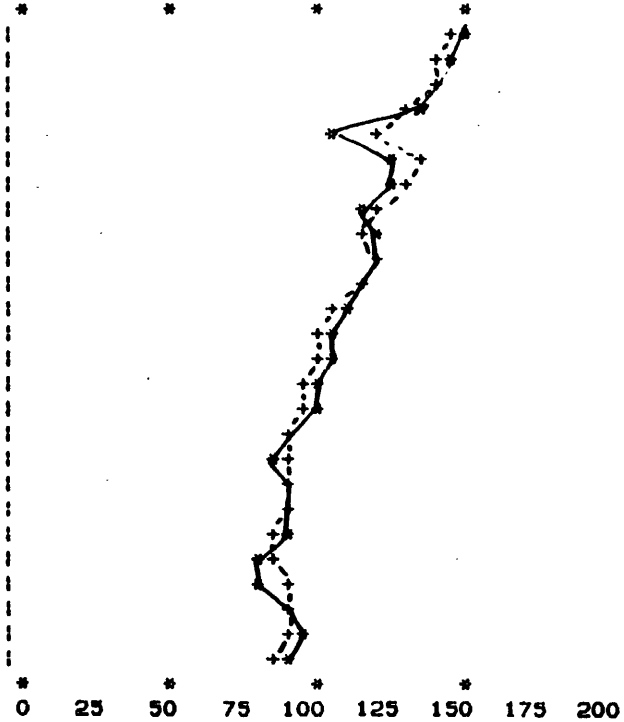
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 472.0 | 442.7 |
| 1953 | 530.6 | 513.3 |
| 1954 | 523.3 | 559.0 |
| 1955 | 578.6 | 661.6 |
| 1956 | 565.3 | 824.8 |
| 1957 | 620.0 | 871.0 |
| 1958 | 605.9 | 747.0 |
| 1959 | 719.8 | 806.5 |
| 1960 | 822.3 | 895.0 |
| 1961 | 855.4 | 937.3 |
| 1962 | 981.9 | 931.2 |
| 1963 | 1044.8 | 1041.1 |
| 1964 | 1241.8 | 1205.5 |
| 1965 | 1598.1 | 1346.3 |
| 1966 | 2011.0 | 1632.2 |
| 1967 | 1913.2 | 1755.4 |
| 1968 | 2251.9 | 1923.6 |
| 1969 | 2554.5 | 2373.8 |
| 1970 | 2521.2 | 2804.0 |
| 1971 | 2777.7 | 2829.7 |
| 1972 | 3544.4 | 3611.1 |
| 1973 | 4306.6 | 4028.3 |
| 1974 | 4486.9 | 4426.1 |
| 1975 | 3739.4 | 3915.6 |
| 1976 | 4239.5 | 4329.6 |
| 1977 | 5080.6 | 5175.0 |



53 AUTO REPAIR (65)

## EMPLOYMENT PER UNIT OF OUTPUT

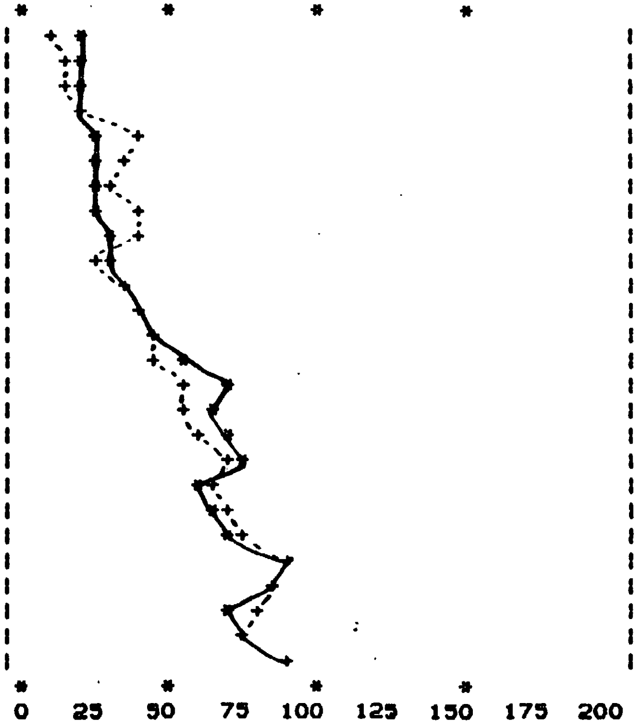
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 2.86 | 2.73 |
| 1953 | 2.76 | 2.68 |
| 1954 | 2.70 | 2.64 |
| 1955 | 2.53 | 2.50 |
| 1956 | 2.01 | 2.24 |
| 1957 | 2.42 | 2.55 |
| 1958 | 2.37 | 2.51 |
| 1959 | 2.21 | 2.28 |
| 1960 | 2.24 | 2.22 |
| 1961 | 2.29 | 2.27 |
| 1962 | 2.18 | 2.15 |
| 1963 | 2.08 | 2.03 |
| 1964 | 2.02 | 1.94 |
| 1965 | 1.98 | 1.92 |
| 1966 | 1.91 | 1.84 |
| 1967 | 1.85 | 1.80 |
| 1968 | 1.73 | 1.72 |
| 1969 | 1.64 | 1.66 |
| 1970 | 1.68 | 1.69 |
| 1971 | 1.69 | 1.67 |
| 1972 | 1.67 | 1.65 |
| 1973 | 1.52 | 1.58 |
| 1974 | 1.55 | 1.71 |
| 1975 | 1.68 | 1.74 |
| 1976 | 1.77 | 1.69 |
| 1977 | 1.73 | 1.64 |



1977 = 100%

## INVESTMENT

| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 407.0 | 234.9 |
| 1953 | 458.0 | 273.9 |
| 1954 | 451.7 | 297.1 |
| 1955 | 495.1 | 421.5 |
| 1956 | 592.5 | 919.2 |
| 1957 | 521.7 | 843.0 |
| 1958 | 513.8 | 746.9 |
| 1959 | 619.8 | 901.1 |
| 1960 | 717.2 | 930.5 |
| 1961 | 711.5 | 631.7 |
| 1962 | 841.2 | 779.6 |
| 1963 | 901.5 | 919.3 |
| 1964 | 1084.4 | 1028.6 |
| 1965 | 1356.3 | 1055.2 |
| 1966 | 1664.6 | 1274.5 |
| 1967 | 1579.6 | 1387.4 |
| 1968 | 1700.5 | 1495.5 |
| 1969 | 1782.3 | 1702.6 |
| 1970 | 1506.3 | 1636.4 |
| 1971 | 1559.0 | 1665.9 |
| 1972 | 1693.8 | 1823.3 |
| 1973 | 2231.1 | 2278.7 |
| 1974 | 2076.4 | 2049.2 |
| 1975 | 1725.2 | 1907.7 |
| 1976 | 1855.7 | 1893.7 |
| 1977 | 2254.9 | 2204.1 |

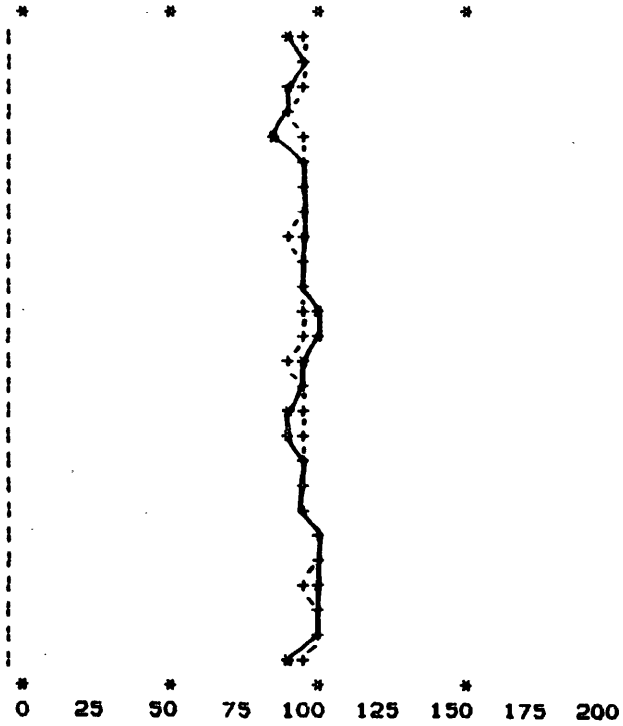


54 MOVIES & AMUSEMENTS (66)

EMPLOYMENT PER UNIT OF OUTPUT

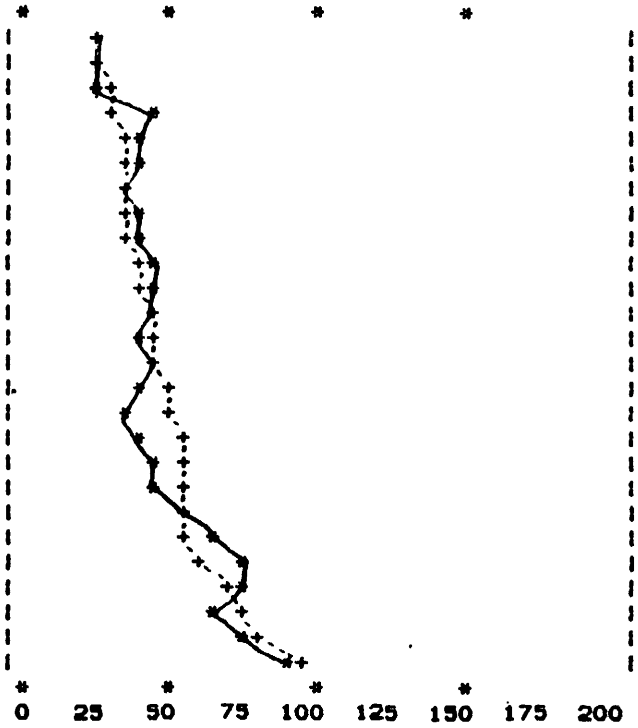
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 4.34 | 4.53 |
| 1953 | 4.53 | 4.54 |
| 1954 | 4.40 | 4.54 |
| 1955 | 4.31 | 4.47 |
| 1956 | 4.22 | 4.53 |
| 1957 | 4.58 | 4.66 |
| 1958 | 4.67 | 4.69 |
| 1959 | 4.71 | 4.53 |
| 1960 | 4.75 | 4.50 |
| 1961 | 4.75 | 4.58 |
| 1962 | 4.76 | 4.62 |
| 1963 | 4.82 | 4.65 |
| 1964 | 4.79 | 4.54 |
| 1965 | 4.63 | 4.49 |
| 1966 | 4.57 | 4.53 |
| 1967 | 4.49 | 4.58 |
| 1968 | 4.46 | 4.62 |
| 1969 | 4.53 | 4.65 |
| 1970 | 4.53 | 4.70 |
| 1971 | 4.64 | 4.75 |
| 1972 | 4.82 | 4.84 |
| 1973 | 4.96 | 4.92 |
| 1974 | 4.92 | 4.75 |
| 1975 | 5.02 | 4.79 |
| 1976 | 4.86 | 4.81 |
| 1977 | 4.47 | 4.75 |

1977 = 100%



INVESTMENT

| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 423.8 | 455.3 |
| 1953 | 477.6 | 466.4 |
| 1954 | 470.1 | 538.3 |
| 1955 | 883.8 | 620.5 |
| 1956 | 810.9 | 640.2 |
| 1957 | 753.1 | 648.3 |
| 1958 | 687.3 | 655.8 |
| 1959 | 758.6 | 643.5 |
| 1960 | 837.7 | 638.0 |
| 1961 | 845.7 | 738.1 |
| 1962 | 930.1 | 823.1 |
| 1963 | 939.5 | 857.2 |
| 1964 | 830.8 | 882.9 |
| 1965 | 844.4 | 941.4 |
| 1966 | 834.0 | 961.7 |
| 1967 | 650.4 | 1040.6 |
| 1968 | 806.5 | 1105.2 |
| 1969 | 920.2 | 1087.5 |
| 1970 | 928.5 | 1051.3 |
| 1971 | 1061.1 | 1093.6 |
| 1972 | 1285.6 | 1120.0 |
| 1973 | 1555.0 | 1203.8 |
| 1974 | 1538.2 | 1428.6 |
| 1975 | 1348.4 | 1542.3 |
| 1976 | 1505.1 | 1638.4 |
| 1977 | 1868.0 | 1972.3 |

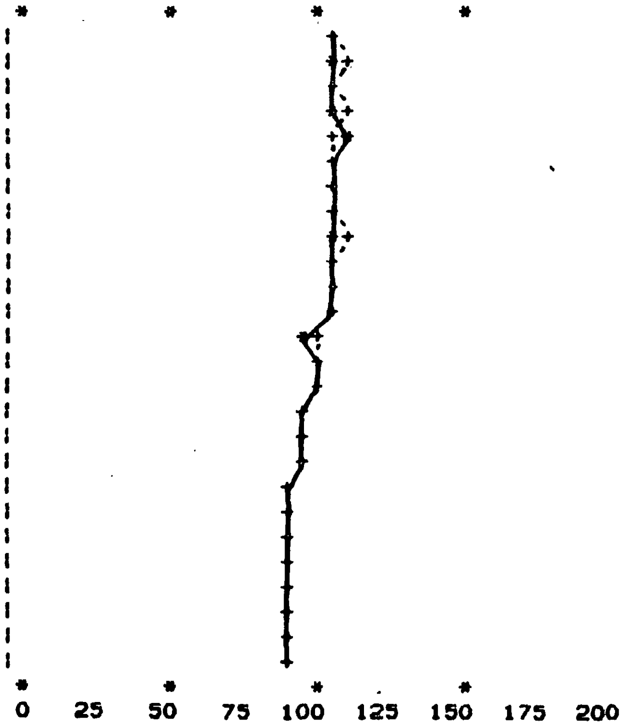


## 55 MEDICAL & ED. SERVICES (67)

### EMPLOYMENT PER UNIT OF OUTPUT

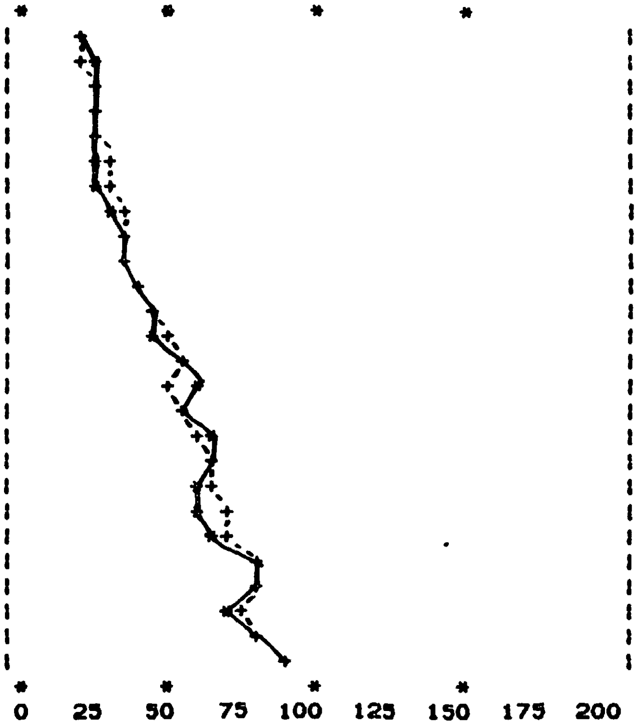
| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 6.30 | 6.38 |
| 1953 | 6.35 | 6.46 |
| 1954 | 6.28 | 6.33 |
| 1955 | 6.40 | 6.42 |
| 1956 | 6.42 | 6.39 |
| 1957 | 6.41 | 6.38 |
| 1958 | 6.38 | 6.31 |
| 1959 | 6.34 | 6.37 |
| 1960 | 6.41 | 6.43 |
| 1961 | 6.37 | 6.29 |
| 1962 | 6.30 | 6.21 |
| 1963 | 6.19 | 6.13 |
| 1964 | 5.73 | 5.81 |
| 1965 | 5.89 | 5.88 |
| 1966 | 5.87 | 5.81 |
| 1967 | 5.69 | 5.69 |
| 1968 | 5.58 | 5.56 |
| 1969 | 5.75 | 5.61 |
| 1970 | 5.37 | 5.47 |
| 1971 | 5.37 | 5.46 |
| 1972 | 5.36 | 5.40 |
| 1973 | 5.35 | 5.40 |
| 1974 | 5.31 | 5.41 |
| 1975 | 5.49 | 5.35 |
| 1976 | 5.35 | 5.30 |
| 1977 | 5.43 | 5.44 |

1977 = 100%



### INVESTMENT

| YEAR | ACT(*) | PRED(+) |
|---|---|---|
| 1952 | 1320.5 | 1306.5 |
| 1953 | 1485.8 | 1339.8 |
| 1954 | 1464.4 | 1529.9 |
| 1955 | 1762.7 | 1676.2 |
| 1956 | 1650.9 | 1688.9 |
| 1957 | 1774.2 | 1871.5 |
| 1958 | 1776.0 | 2014.3 |
| 1959 | 2050.6 | 2168.3 |
| 1960 | 2309.7 | 2315.8 |
| 1961 | 2407.8 | 2444.6 |
| 1962 | 2764.0 | 2715.4 |
| 1963 | 2922.8 | 2934.2 |
| 1964 | 3197.8 | 3279.8 |
| 1965 | 3782.3 | 3839.8 |
| 1966 | 4315.1 | 3568.0 |
| 1967 | 3952.2 | 3664.8 |
| 1968 | 4376.3 | 4072.2 |
| 1969 | 4446.3 | 4433.5 |
| 1970 | 4083.8 | 4362.2 |
| 1971 | 4200.7 | 4818.0 |
| 1972 | 4650.3 | 4941.1 |
| 1973 | 5713.2 | 5477.8 |
| 1974 | 5529.5 | 5704.4 |
| 1975 | 5026.9 | 5062.3 |
| 1976 | 5542.5 | 5441.4 |
| 1977 | 6416.2 | 6252.0 |



# APPENDIX D: ESTIMATES WITH A CONSTANT TIME TREND

## ELASTICITIES

| | PK | PL | PE | SIGMA | CSTSHR | FIT | RHO |
|---|---|---|---|---|---|---|---|
| 1 FARMS AGR. SERVICES,FORESTRY,FISHERY | | | | | | | |
| CAPITAL | -0.352 | 0.058 | 0.294 | * | * | 12.4 | 0.501 |
| LABOR | 0.246 | -0.285 | 0.038 | 0.290 | 0.200 | 7.5 | 0.859 |
| 2 CRUDE PETROLEUM AND NATURAL GAS (4) | | | | | | | |
| CAPITAL | -0.161 | 0.000 | 0.161 | * | * | 21.8 | 0.604 |
| LABOR | 0.000 | -1.048 | 1.048 | 0.000 | 0.161 | 9.7 | 0.820 |
| 3 MINING (2,3,5) | | | | | | | |
| CAPITAL | -0.233 | 0.002 | 0.231 | * | * | 31.9 | 0.801 |
| LABOR | 0.031 | -0.694 | 0.662 | 0.006 | 0.337 | 4.4 | 0.527 |
| 4 CONSTRUCTION (6) | | | | | | | |
| CAPITAL | -0.217 | 0.000 | 0.217 | * | * | 14.5 | 0.524 |
| LABOR | 0.000 | -0.358 | 0.358 | 0.000 | 0.657 | 7.3 | 0.870 |
| 5 FOOD, TOBACCO (7) | | | | | | | |
| CAPITAL | -0.037 | 0.003 | 0.033 | * | * | 9.9 | 0.500 |
| LABOR | 0.020 | -0.120 | 0.099 | 0.024 | 0.133 | 3.2 | 0.817 |
| 6 TEXTILES (8) | | | | | | | |
| CAPITAL | -0.000 | 0.112 | -0.112 | * | * | 15.3 | 0.567 |
| LABOR | 0.444 | -0.047 | -0.396 | 0.421 | 0.265 | 8.6 | 0.857 |
| 7 KNITTING, HOSIERY (9) | | | | | | | |
| CAPITAL | -0.000 | 0.432 | -0.432 | * | * | 21.5 | 0.500 |
| LABOR | 0.319 | -0.353 | 0.034 | 2.124 | 0.203 | 3.9 | 0.426 |
| 8 APPAREL AND HOUSEHOLD TEXTILES (10) | | | | | | | |
| CAPITAL | -0.000 | 0.144 | -0.144 | * | * | 12.8 | 0.502 |
| LABOR | 0.276 | -0.211 | -0.065 | 0.607 | 0.237 | 5.3 | 0.648 |

# ELASTICITIES

| | PK | PL | PE | SIGMA | CSTSHR | FIT | RHO |
|---|---|---|---|---|---|---|---|
| 9 PAPER (11) | | | | | | | |
| CAPITAL | -0.003 | 0.005 | -0.001 | * | * | 13.5 | 0.502 |
| LABOR | 0.182 | -0.161 | -0.021 | 0.020 | 0.242 | 1.7 | 0.388 |
| 10 PRINTING (12) | | | | | | | |
| CAPITAL | 0.000 | 0.033 | -0.033 | * | * | 8.7 | 0.553 |
| LABOR | 0.158 | -0.279 | 0.122 | 0.091 | 0.359 | 4.1 | 0.788 |
| 11 AGRICULTURE FERTILIZERS (13) | | | | | | | |
| CAPITAL | -0.711 | 0.026 | 0.685 | * | * | 23.8 | 0.518 |
| LABOR | 0.829 | -1.281 | 0.452 | 0.241 | 0.108 | 6.4 | 0.319 |
| 12 OTHER CHEMICALS (14) | | | | | | | |
| CAPITAL | -0.233 | 0.000 | 0.233 | * | * | 12.2 | 0.581 |
| LABOR | 0.000 | -0.136 | 0.136 | 0.000 | 0.190 | 2.8 | 0.477 |
| 13 PETROLEUM REFINING & FUEL OIL (15,16 | | | | | | | |
| CAPITAL | -0.251 | 0.007 | 0.245 | * | * | 30.8 | 0.515 |
| LABOR | 0.168 | -0.526 | 0.358 | 0.165 | 0.042 | 3.2 | 0.618 |
| 14 RUBBER AND PLASTIC PRODUCTS (17,18) | | | | | | | |
| CAPITAL | 0.000 | 0.010 | -0.010 | * | * | 9.8 | 0.576 |
| LABOR | 0.244 | -0.636 | 0.392 | 0.034 | 0.289 | 3.7 | 0.587 |
| 15 FOOTWEAR AND LEATHER (19) | | | | | | | |
| CAPITAL | -0.045 | 0.062 | -0.016 | * | * | 8.0 | 0.505 |
| LABOR | 0.143 | -0.003 | -0.139 | 0.186 | 0.331 | 2.5 | 0.190 |
| 16 LUMBER (20) | | | | | | | |
| CAPITAL | -0.000 | 0.019 | -0.019 | * | * | 11.0 | 0.500 |
| LABOR | 0.105 | -0.142 | 0.037 | 0.085 | 0.219 | 4.6 | 0.057 |

ELASTICITIES

| | PK | PL | PE | SIGMA | CSTSHR | FIT | RHO |
|---|---|---|---|---|---|---|---|
| 17 FUNITURE (21) | | | | | | | |
| CAPITAL | -0.000 | 0.211 | -0.211 | * | * | 13.1 | 0.500 |
| LABOR | 0.827 | -0.826 | -0.002 | 0.639 | 0.331 | 3.1 | 0.638 |
| 18 STONE,CLAY & GLASS (22) | | | | | | | |
| CAPITAL | -0.000 | 0.015 | -0.015 | * | * | 14.7 | 0.506 |
| LABOR | 0.461 | -0.547 | 0.086 | 0.047 | 0.319 | 1.5 | -0.210 |
| 19 IRON AND STEEL (23) | | | | | | | |
| CAPITAL | -0.000 | 0.006 | -0.006 | * | * | 38.6 | 0.520 |
| LABOR | 0.268 | -0.104 | -0.163 | 0.025 | 0.257 | 4.9 | 0.665 |
| 20 NON-FERROUS METALS (24,25) | | | | | | | |
| CAPITAL | -0.000 | 0.009 | -0.009 | * | * | 25.6 | 0.573 |
| LABOR | 0.561 | -0.878 | 0.316 | 0.045 | 0.191 | 2.5 | 0.243 |
| 21 METAL PRODUCTS (26) | | | | | | | |
| CAPITAL | -0.000 | 0.016 | -0.016 | * | * | 11.1 | 0.518 |
| LABOR | 0.228 | -0.586 | 0.358 | 0.053 | 0.309 | 3.7 | 0.570 |
| 22 ENGINES & TURBINS (27) | | | | | | | |
| CAPITAL | 0.000 | 0.039 | -0.039 | * | * | 16.1 | 0.518 |
| LABOR | 0.681 | -1.271 | 0.590 | 0.173 | 0.228 | 8.5 | 0.380 |
| 23 AGRICULTURE MACHINERY (28) | | | | | | | |
| CAPITAL | -0.000 | 0.174 | -0.174 | * | * | 29.2 | 0.538 |
| LABOR | 1.024 | -0.573 | -0.450 | 0.721 | 0.241 | 9.0 | 0.475 |

## ELASTICITIES

| | PK | PL | PE | SIGMA | CSTSHR | FIT | RHO |
|---|---|---|---|---|---|---|---|
| 25 METALWORKING MACHINERY (30) | | | | | | | |
| CAPITAL | -0.000 | 0.047 | -0.047 | * | * | 18.8 | 0.513 |
| LABOR | 0.568 | -0.635 | 0.067 | 0.109 | 0.436 | 3.3 | 0.288 |
| 27 SPECIAL INDUCTRY MACHINERY (31) | | | | | | | |
| CAPITAL | -0.000 | 0.037 | -0.037 | * | * | 22.3 | 0.507 |
| LABOR | 0.406 | -0.775 | 0.370 | 0.102 | 0.367 | 6.2 | 0.525 |
| 28 MISC.NONELEC. MACHINERY (29,32) | | | | | | | |
| CAPITAL | -0.000 | 0.091 | -0.091 | * | * | 11.2 | 0.500 |
| LABOR | 0.557 | -0.769 | 0.212 | 0.262 | 0.346 | 2.6 | 0.247 |
| 29 COMPUTERS & OTHER OFFICE MACHINERY ( | | | | | | | |
| CAPITAL | -0.000 | 0.244 | -0.244 | * | * | 28.8 | 0.500 |
| LABOR | 1.221 | -0.862 | -0.359 | 0.790 | 0.309 | 11.5 | 0.777 |
| 30 SERVICE INDUCTRY MACHINERY (35) | | | | | | | |
| CAPITAL | -0.000 | 0.070 | -0.070 | * | * | 22.8 | 0.500 |
| LABOR | 0.602 | -1.288 | 0.685 | 0.291 | 0.239 | 5.5 | 0.488 |
| 31 COMMUNICATIONS MACHINERY (36) | | | | | | | |
| CAPITAL | -0.000 | 0.438 | -0.438 | * | * | 20.2 | 0.543 |
| LABOR | 1.851 | -1.971 | 0.119 | 1.171 | 0.374 | 7.8 | 0.469 |
| 32 HEAVY ELECTRICAL MACHINERY (37) | | | | | | | |
| CAPITAL | -0.000 | 0.139 | -0.139 | * | * | 12.9 | 0.516 |
| LABOR | 1.111 | -0.861 | -0.250 | 0.457 | 0.305 | 7.1 | 0.702 |

## ELASTICITIES

| | PK | PL | PE | SIGMA | CSTSHR | FIT | RHO |
|---|---|---|---|---|---|---|---|
| 33 HOUSEHOLD APPLIANCES (38) | | | | | | | |
| CAPITAL | -0.000 | 0.244 | -0.244 | * | * | 23.7 | 0.513 |
| LABOR | 2.754 | -2.607 | -0.147 | 0.923 | 0.264 | 11.8 | 0.863 |
| 34 ELECTRICAL LIGHTING & WIRING EQUIP ( | | | | | | | |
| CAPITAL | -0.000 | 0.043 | -0.043 | * | * | 14.8 | 0.525 |
| LABOR | 0.874 | -1.286 | 0.412 | 0.118 | 0.366 | 2.6 | 0.301 |
| 35 RADIO,T.V.RECEIVING,PHONOGRAPH (40) | | | | | | | |
| CAPITAL | -0.082 | 0.770 | -0.688 | * | * | 22.1 | 0.565 |
| LABOR | 1.225 | -1.224 | -0.002 | 2.768 | 0.278 | 13.3 | 0.546 |
| 36 MOTOR VEHICLES (41) | | | | | | | |
| CAPITAL | -0.000 | 0.067 | -0.067 | * | * | 34.7 | 0.510 |
| LABOR | 0.287 | 0.000 | -0.287 | 0.331 | 0.202 | 23.3 | 0.981 |
| 37 AEROSPACE (42) | | | | | | | |
| CAPITAL | -0.624 | 0.000 | 0.624 | * | * | 42.4 | 0.506 |
| LABOR | 0.000 | -0.467 | 0.467 | 0.000 | 0.334 | 9.6 | 0.616 |
| 38 SHIPS & BOATS (43) | | | | | | | |
| CAPITAL | -0.243 | 0.193 | 0.050 | * | * | 33.2 | 0.610 |
| LABOR | 0.632 | -0.613 | -0.019 | 0.464 | 0.415 | 4.4 | 0.225 |
| 39 OTHER TRANSPORTATION EQUIP. (44) | | | | | | | |
| CAPITAL | -0.000 | 0.609 | -0.609 | * | * | 31.3 | 0.547 |
| LABOR | 0.718 | -0.000 | -0.718 | 1.185 | 0.514 | 22.6 | 0.752 |
| 40 INSTRUMENTS (45) | | | | | | | |
| CAPITAL | -0.000 | 0.187 | -0.187 | * | * | 9.1 | 0.503 |
| LABOR | 0.746 | -0.358 | -0.388 | 0.476 | 0.394 | 4.7 | 0.662 |

## ELASTICITIES

| | | PK | PL | PE | SIGMA | CSTSHR | FIT | RHO |
|---|---|---|---|---|---|---|---|---|
| 41 MISC. MFG. (46) | | | | | | | | |
| | CAPITAL | -0.000 | 0.070 | -0.070 | * | * | 12.5 | 0.502 |
| | LABOR | 0.330 | -0.702 | 0.372 | 0.253 | 0.277 | 3.5 | 0.599 |
| 42 RAILROADS (47) | | | | | | | | |
| | CAPITAL | -0.010 | 0.014 | -0.004 | * | * | 13.5 | 0.522 |
| | LABOR | 0.572 | -0.984 | 0.412 | 0.027 | 0.528 | 1.9 | 0.175 |
| 43 AIR TRANSPORT (50) | | | | | | | | |
| | CAPITAL | -0.000 | 0.008 | -0.008 | * | * | 23.9 | 0.522 |
| | LABOR | 0.771 | -1.071 | 0.300 | 0.020 | 0.380 | 3.6 | 0.519 |
| 44 TRUCKING AND OTHER TRANSPORT (48,49, | | | | | | | | |
| | CAPITAL | -0.000 | 0.015 | -0.015 | * | * | 18.7 | 0.633 |
| | LABOR | 0.142 | -0.000 | -0.142 | 0.034 | 0.431 | 2.5 | 0.580 |
| 45 COMMUNICATIONS SERVICES (53) | | | | | | | | |
| | CAPITAL | 0.000 | 0.001 | -0.001 | * | * | 16.2 | 0.523 |
| | LABOR | 0.036 | -0.155 | 0.119 | 0.002 | 0.414 | 4.0 | 0.842 |
| 46 ELECTRIC UTILITIES (54) | | | | | | | | |
| | CAPITAL | -0.000 | 0.001 | -0.001 | * | * | 12.2 | 0.518 |
| | LABOR | 0.105 | -0.303 | 0.198 | 0.006 | 0.209 | 1.4 | 0.383 |
| 47 GAS,WATER & SANITATION (55,56) | | | | | | | | |
| | CAPITAL | -0.734 | 0.000 | 0.734 | * | * | 24.8 | 0.555 |
| | LABOR | 0.000 | -0.529 | 0.529 | 0.000 | 0.067 | 4.5 | 0.790 |
| 48 WHOLESALE & RETAIL TRADE (57,58) | | | | | | | | |
| | CAPITAL | -0.128 | 0.075 | 0.054 | * | * | 7.1 | 0.509 |
| | LABOR | 0.132 | -0.352 | 0.220 | 0.124 | 0.604 | 1.2 | 0.315 |

## ELASTICITIES

| | PK | PL | PE | SIGMA | CSTSHR | FIT | RHO |
|---|---|---|---|---|---|---|---|
| 49 FINANCE & INSURANCE (60) | | | | | | | |
| CAPITAL | -0.000 | 0.015 | -0.015 | * | * | 10.5 | 0.500 |
| LABOR | 0.052 | -0.002 | -0.050 | 0.031 | 0.471 | 1.4 | 0.235 |
| 50 REAL ESTATE (61) | | | | | | | |
| CAPITAL | -0.118 | 0.014 | 0.104 | * | * | 21.1 | 0.505 |
| LABOR | 0.161 | -0.453 | 0.292 | 0.177 | 0.080 | 7.9 | 0.720 |
| 51 HOTELS & REPAIRS MINUS AUTO (63) | | | | | | | |
| CAPITAL | -0.107 | 0.007 | 0.100 | * | * | 16.2 | 0.501 |
| LABOR | 0.020 | -0.039 | 0.018 | 0.012 | 0.595 | 1.9 | 0.394 |
| 52 BUSINESS SERVICES (64) | | | | | | | |
| CAPITAL | -0.000 | 0.013 | -0.013 | * | * | 8.9 | 0.506 |
| LABOR | 0.056 | -0.000 | -0.056 | 0.030 | 0.451 | 2.5 | 0.552 |
| 53 AUTO REPAIR (65) | | | | | | | |
| CAPITAL | 0.000 | 0.005 | -0.005 | * | * | 15.5 | 0.501 |
| LABOR | 0.086 | -0.354 | 0.268 | 0.020 | 0.247 | 4.3 | 0.590 |
| 54 MOVIES & AMUSEMENTS (66) | | | | | | | |
| CAPITAL | -0.173 | 0.000 | 0.173 | * | * | 17.7 | 0.508 |
| LABOR | 0.000 | 0.000 | -0.000 | 0.000 | 0.415 | 4.3 | 0.794 |
| 55 MEDICAL & ED. SERVICES (67) | | | | | | | |
| CAPITAL | -0.144 | 0.015 | 0.129 | * | * | 7.0 | 0.509 |
| LABOR | 0.174 | -0.315 | 0.141 | 0.026 | 0.581 | 1.3 | 0.290 |

## APPENDIX E: ESTIMATES WITH SLOPE DUMMY FOR TREND IN 1970

### ELASTICITIES

| | PK | PL | PE | SIGMA | CSTSHR | FIT | RHO |
|---|---|---|---|---|---|---|---|
| 1 FARMS AGR. SERVICES,FORESTRY,FISHERY | | | | | | | |
| CAPITAL | -0.421 | 0.121 | 0.299 | * | * | 11.9 | 0.502 |
| LABOR | 0.390 | -0.223 | -0.167 | 0.608 | 0.200 | 7.5 | 0.725 |
| 2 CRUDE PETROLEUM AND NATURAL GAS (4) | | | | | | | |
| CAPITAL | -0.161 | 0.000 | 0.161 | * | * | 21.8 | 0.604 |
| LABOR | 0.000 | -1.378 | 1.378 | 0.000 | 0.161 | 6.2 | 0.476 |
| 3 MINING (2,3,5) | | | | | | | |
| CAPITAL | -0.240 | 0.010 | 0.230 | * | * | 32.0 | 0.802 |
| LABOR | 0.152 | -0.730 | 0.578 | 0.029 | 0.337 | 3.5 | 0.357 |
| 4 CONSTRUCTION (6) | | | | | | | |
| CAPITAL | -0.217 | 0.000 | 0.217 | * | * | 14.5 | 0.524 |
| LABOR | 0.000 | -0.185 | 0.185 | 0.000 | 0.657 | 3.7 | 0.490 |
| 5 FOOD, TOBACCO (7) | | | | | | | |
| CAPITAL | -0.037 | 0.004 | 0.033 | * | * | 9.9 | 0.500 |
| LABOR | 0.024 | -0.041 | 0.018 | 0.031 | 0.133 | 2.9 | 0.745 |
| 6 TEXTILES (8) | | | | | | | |
| CAPITAL | 0.000 | 0.202 | -0.202 | * | * | 14.0 | 0.570 |
| LABOR | 0.630 | -0.082 | -0.548 | 0.760 | 0.265 | 9.4 | 0.748 |
| 7 KNITTING, HOSIERY (9) | | | | | | | |
| CAPITAL | 0.000 | 0.432 | -0.432 | * | * | 21.5 | 0.500 |
| LABOR | 0.319 | -0.353 | 0.034 | 2.124 | 0.203 | 3.9 | 0.426 |
| 8 APPAREL AND HOUSEHOLD TEXTILES (10) | | | | | | | |
| CAPITAL | 0.000 | 0.190 | -0.190 | * | * | 12.7 | 0.501 |
| LABOR | 0.315 | -0.155 | -0.159 | 0.801 | 0.237 | 5.2 | 0.587 |

## ELASTICITIES

| | PK | PL | PE | SIGMA | CSTSHR | FIT | RHO |
|---|---|---|---|---|---|---|---|
| 9 PAPER (11) | | | | | | | |
| CAPITAL | -0.003 | 0.005 | -0.001 | * | * | 13.5 | 0.502 |
| LABOR | 0.182 | -0.161 | -0.021 | 0.020 | 0.242 | 1.7 | 0.389 |
| 10 PRINTING (12) | | | | | | | |
| CAPITAL | 0.000 | 0.052 | -0.052 | * | * | 8.5 | 0.555 |
| LABOR | 0.216 | -0.203 | -0.013 | 0.144 | 0.359 | 2.9 | 0.660 |
| 11 AGRICULTURE FERTILIZERS (13) | | | | | | | |
| CAPITAL | -0.712 | 0.028 | 0.685 | * | * | 23.8 | 0.518 |
| LABOR | 0.840 | -1.236 | 0.396 | 0.256 | 0.108 | 5.8 | 0.140 |
| 12 OTHER CHEMICALS (14) | | | | | | | |
| CAPITAL | -0.233 | 0.000 | 0.233 | * | * | 12.2 | 0.581 |
| LABOR | 0.000 | -0.105 | 0.105 | 0.000 | 0.190 | 2.7 | 0.475 |
| 13 PETROLEUM REFINING & FUEL OIL (15,16 | | | | | | | |
| CAPITAL | -0.251 | 0.005 | 0.246 | * | * | 30.8 | 0.515 |
| LABOR | 0.110 | -0.313 | 0.204 | 0.120 | 0.042 | 2.4 | 0.353 |
| 14 RUBBER AND PLASTIC PRODUCTS (17,18) | | | | | | | |
| CAPITAL | 0.000 | 0.010 | -0.010 | * | * | 9.8 | 0.577 |
| LABOR | 0.251 | -0.615 | 0.364 | 0.036 | 0.289 | 3.7 | 0.581 |
| 15 FOOTWEAR AND LEATHER (19) | | | | | | | |
| CAPITAL | -0.045 | 0.061 | -0.016 | * | * | 8.0 | 0.505 |
| LABOR | 0.142 | -0.003 | -0.139 | 0.186 | 0.331 | 2.5 | 0.190 |
| 16 LUMBER (20) | | | | | | | |
| CAPITAL | -0.000 | 0.026 | -0.026 | * | * | 10.9 | 0.500 |
| LABOR | 0.142 | -0.137 | -0.005 | 0.120 | 0.219 | 4.5 | -0.018 |

## ELASTICITIES

| | PK | PL | PE | SIGMA | CSTSHR | FIT | RHO |
|---|---|---|---|---|---|---|---|
| 17 FUNITURE (21) | | | | | | | |
| CAPITAL | -0.000 | 0.211 | -0.211 | * | * | 13.1 | 0.500 |
| LABOR | 0.827 | -0.826 | -0.002 | 0.639 | 0.331 | 3.1 | 0.638 |
| 18 STONE,CLAY & GLASS (22) | | | | | | | |
| CAPITAL | 0.000 | 0.014 | -0.014 | * | * | 14.7 | 0.506 |
| LABOR | 0.429 | -0.486 | 0.056 | 0.045 | 0.319 | 1.4 | -0.385 |
| 19 IRON AND STEEL (23) | | | | | | | |
| CAPITAL | -0.000 | 0.006 | -0.006 | * | * | 38.6 | 0.520 |
| LABOR | 0.268 | -0.105 | -0.163 | 0.025 | 0.257 | 4.9 | 0.665 |
| 20 NON-FERROUS METALS (24,25) | | | | | | | |
| CAPITAL | -0.000 | 0.009 | -0.009 | * | * | 25.5 | 0.573 |
| LABOR | 0.596 | -0.876 | 0.279 | 0.049 | 0.191 | 2.4 | 0.212 |
| 21 METAL PRODUCTS (26) | | | | | | | |
| CAPITAL | 0.000 | 0.020 | -0.020 | * | * | 11.0 | 0.519 |
| LABOR | 0.241 | -0.444 | 0.203 | 0.064 | 0.309 | 2.8 | 0.217 |
| 22 ENGINES & TURBINS (27) | | | | | | | |
| CAPITAL | 0.000 | 0.040 | -0.040 | * | * | 16.1 | 0.518 |
| LABOR | 0.682 | -1.272 | 0.590 | 0.173 | 0.228 | 8.5 | 0.380 |
| 23 AGRICULTURE MACHINERY (28) | | | | | | | |
| CAPITAL | 0.000 | 0.203 | -0.203 | * | * | 28.8 | 0.545 |
| LABOR | 0.974 | -0.369 | -0.605 | 0.841 | 0.241 | 9.3 | 0.490 |

## ELASTICITIES

| | PK | PL | PE | SIGMA | CSTSHR | FIT | RHO |
|---|---|---|---|---|---|---|---|
| 25 METALWORKING MACHINERY (30) | | | | | | | |
| CAPITAL | 0.000 | 0.047 | -0.047 | * | * | 18.8 | 0.513 |
| LABOR | 0.568 | -0.635 | 0.067 | 0.109 | 0.436 | 3.3 | 0.288 |
| 27 SPECIAL INDUCTRY MACHINERY (31) | | | | | | | |
| CAPITAL | 0.000 | 0.053 | -0.053 | * | * | 22.1 | 0.509 |
| LABOR | 0.526 | -0.790 | 0.264 | 0.145 | 0.367 | 6.0 | 0.437 |
| 28 MISC.NONELEC. MACHINERY (29,32) | | | | | | | |
| CAPITAL | -0.000 | 0.091 | -0.091 | * | * | 11.2 | 0.500 |
| LABOR | 0.558 | -0.769 | 0.212 | 0.262 | 0.346 | 2.6 | 0.247 |
| 29 COMPUTERS & OTHER OFFICE MACHINERY ( | | | | | | | |
| CAPITAL | -0.000 | 0.275 | -0.275 | * | * | 28.3 | 0.500 |
| LABOR | 2.114 | -1.802 | -0.312 | 0.890 | 0.309 | 9.7 | 0.635 |
| 30 SERVICE INDUCTRY MACHINERY (35) | | | | | | | |
| CAPITAL | 0.000 | 0.101 | -0.101 | * | * | 22.3 | 0.500 |
| LABOR | 0.700 | -1.191 | 0.491 | 0.423 | 0.239 | 5.2 | 0.378 |
| 31 COMMUNICATIONS MACHINERY (36) | | | | | | | |
| CAPITAL | 0.000 | 0.504 | -0.504 | * | * | 19.8 | 0.539 |
| LABOR | 2.804 | -3.317 | 0.513 | 1.349 | 0.374 | 9.1 | 0.551 |
| 32 HEAVY ELECTRICAL MACHINERY (37) | | | | | | | |
| CAPITAL | 0.000 | 0.139 | -0.139 | * | * | 12.9 | 0.516 |
| LABOR | 1.111 | -0.861 | -0.250 | 0.457 | 0.305 | 7.1 | 0.702 |

## ELASTICITIES

| | PK | PL | PE | SIGMA | CSTSHR | FIT | RHO |
|---|---|---|---|---|---|---|---|
| 33 HOUSEHOLD APPLIANCES (38) | | | | | | | |
| CAPITAL | -0.000 | 0.459 | -0.459 | * | * | 24.3 | 0.508 |
| LABOR | 0.933 | -0.905 | -0.028 | 1.737 | 0.264 | 22.0 | 0.980 |
| 34 ELECTRICAL LIGHTING & WIRING EQUIP ( | | | | | | | |
| CAPITAL | -0.000 | 0.043 | -0.043 | * | * | 14.8 | 0.525 |
| LABOR | 0.874 | -1.286 | 0.412 | 0.118 | 0.366 | 2.6 | 0.301 |
| 35 RADIO,T.V.RECEIVING,PHONOGRAPH (40) | | | | | | | |
| CAPITAL | -0.095 | 0.787 | -0.692 | * | * | 22.0 | 0.564 |
| LABOR | 3.560 | -5.146 | 1.586 | 2.832 | 0.278 | 12.6 | 0.491 |
| 36 MOTOR VEHICLES (41) | | | | | | | |
| CAPITAL | -0.000 | 0.043 | -0.043 | * | * | 34.8 | 0.510 |
| LABOR | 0.411 | -0.212 | -0.199 | 0.213 | 0.202 | 14.8 | 0.962 |
| 37 AEROSPACE (42) | | | | | | | |
| CAPITAL | -0.624 | 0.000 | 0.624 | * | * | 42.4 | 0.506 |
| LABOR | 0.000 | -0.295 | 0.295 | 0.000 | 0.334 | 8.1 | 0.512 |
| 38 SHIPS & BOATS (43) | | | | | | | |
| CAPITAL | -0.245 | 0.195 | 0.049 | * | * | 33.2 | 0.610 |
| LABOR | 0.624 | -0.583 | -0.042 | 0.470 | 0.415 | 4.4 | 0.204 |
| 39 OTHER TRANSPORTATION EQUIP. (44) | | | | | | | |
| CAPITAL | -0.000 | 0.609 | -0.609 | * | * | 31.3 | 0.547 |
| LABOR | 0.718 | -0.000 | -0.718 | 1.185 | 0.514 | 22.6 | 0.752 |
| 40 INSTRUMENTS (45) | | | | | | | |
| CAPITAL | -0.000 | 0.187 | -0.187 | * | * | 9.1 | 0.503 |
| LABOR | 0.746 | -0.358 | -0.388 | 0.476 | 0.394 | 4.7 | 0.662 |

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|---|---|---|---|---|---|---|---|
| 41 MISC. MFG. (46) | | | | | | | |
| CAPITAL | 0.000 | 0.086 | -0.086 | * | * | 12.4 | 0.502 |
| LABOR | 0.374 | -0.629 | 0.256 | 0.310 | 0.277 | 2.9 | 0.331 |
| 42 RAILROADS (47) | | | | | | | |
| CAPITAL | -0.011 | 0.015 | -0.005 | * | * | 13.5 | 0.522 |
| LABOR | 0.612 | -1.016 | 0.404 | 0.029 | 0.528 | 1.8 | 0.108 |
| 43 AIR TRANSPORT (50) | | | | | | | |
| CAPITAL | 0.000 | 0.008 | -0.008 | * | * | 23.9 | 0.522 |
| LABOR | 0.810 | -1.101 | 0.291 | 0.021 | 0.380 | 3.6 | 0.511 |
| 44 TRUCKING AND OTHER TRANSPORT (48,49, | | | | | | | |
| CAPITAL | 0.000 | 0.015 | -0.015 | * | * | 18.7 | 0.633 |
| LABOR | 0.142 | 0.000 | -0.142 | 0.034 | 0.431 | 2.5 | 0.580 |
| 45 COMMUNICATIONS SERVICES (53) | | | | | | | |
| CAPITAL | 0.000 | 0.003 | -0.003 | * | * | 16.2 | 0.524 |
| LABOR | 0.098 | -0.000 | -0.098 | 0.007 | 0.414 | 3.1 | 0.691 |
| 46 ELECTRIC UTILITIES (54) | | | | | | | |
| CAPITAL | 0.000 | 0.001 | -0.001 | * | * | 12.1 | 0.518 |
| LABOR | 0.105 | -0.300 | 0.195 | 0.006 | 0.209 | 1.4 | 0.383 |
| 47 GAS,WATER & SANITATION (55,56) | | | | | | | |
| CAPITAL | -0.734 | 0.000 | 0.734 | * | * | 24.8 | 0.555 |
| LABOR | 0.000 | -0.480 | 0.480 | 0.000 | 0.067 | 2.6 | 0.378 |
| 48 WHOLESALE & RETAIL TRADE (57,58) | | | | | | | |
| CAPITAL | -0.135 | 0.086 | 0.050 | * | * | 7.1 | 0.510 |
| LABOR | 0.148 | -0.338 | 0.190 | 0.142 | 0.604 | 1.0 | 0.119 |

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| | PK | PL | PE | SIGMA | CSTSHR | FIT | RHO |
|---|---|---|---|---|---|---|---|
| 49 FINANCE & INSURANCE (60) | | | | | | | |
| CAPITAL | -0.000 | 0.015 | -0.015 | * | * | 10.5 | 0.500 |
| LABOR | 0.052 | -0.002 | -0.050 | 0.031 | 0.471 | 1.4 | 0.235 |
| 50 REAL ESTATE (61) | | | | | | | |
| CAPITAL | -0.127 | 0.026 | 0.101 | * | * | 21.1 | 0.504 |
| LABOR | 0.290 | -0.449 | 0.159 | 0.326 | 0.080 | 6.3 | 0.563 |
| 51 HOTELS & REPAIRS MINUS AUTO (63) | | | | | | | |
| CAPITAL | -0.107 | 0.007 | 0.100 | * | * | 16.3 | 0.501 |
| LABOR | 0.020 | -0.030 | 0.010 | 0.012 | 0.595 | 1.9 | 0.332 |
| 52 BUSINESS SERVICES (64) | | | | | | | |
| CAPITAL | -0.000 | 0.013 | -0.013 | * | * | 8.9 | 0.506 |
| LABOR | 0.056 | -0.000 | -0.056 | 0.030 | 0.451 | 2.5 | 0.552 |
| 53 AUTO REPAIR (65) | | | | | | | |
| CAPITAL | 0.000 | 0.005 | -0.005 | * | * | 15.5 | 0.501 |
| LABOR | 0.086 | -0.344 | 0.259 | 0.020 | 0.247 | 4.3 | 0.592 |
| 54 MOVIES & AMUSEMENTS (66) | | | | | | | |
| CAPITAL | -0.174 | 0.001 | 0.173 | * | * | 17.7 | 0.507 |
| LABOR | 0.033 | -0.009 | -0.025 | 0.002 | 0.415 | 3.7 | 0.714 |
| 55 MEDICAL & ED. SERVICES (67) | | | | | | | |
| CAPITAL | -0.144 | 0.015 | 0.128 | * | * | 7.0 | 0.508 |
| LABOR | 0.174 | -0.315 | 0.141 | 0.026 | 0.581 | 1.3 | 0.290 |