BUSINESS EXPECTATIONS AND PLANT EXPANSION

With Special Reference to
the Rubber Industry

DISSERTATION

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leading up to Hicks' contribution follows.

Critical opinion usually credits John Maurice Clark with being the first modern economist to recognize and label the economic conditions of the accelerator, as is pointed out above. His work was not very rigorous mathematically and he made relatively few statistical tests of his models. His work did not refer, for example, to some important problems of cycle theory: What are the initiating factors in the oscillations and what are the conditions under which the oscillations are likely to be explosive, damped, or constant?

Ragnar Frisch offered an explanation of the initiating factors in the oscillations and some conclusions on how these factors seem likely to be sufficient for maintaining the oscillations. Initiating factors he said are "exogenous" to the economic system under consideration (for example war, famine, flood, technological change) and come upon it at erratic intervals. These shocks may be likened to successive blows struck at a pendulum swinging against some friction. The blows keep the pendulum swinging at varying amplitudes and speeds. Erratic shocks instigate oscillations, irregular in

6 T. N. Carver, Aftalion, and Bickerdike clearly formulated such a principle prior to Clark's article in 1919. See Fisher, loc. cit., pp 474-7.

Modigliani suggests that a multivariate analysis of ex post data (on sales, investment, prices, and so on) be carried out. 20

Management interviews should provide information on the extent of forward planning, degree of formalization and adherence to such planning, as well as the role of budgets.

The basic hypothesis employed in the Merrill Project was that "current expectations together with other current data" exert a significant influence on forward investment plans.

The investigators sought to employ a "panel study" concerned with the role of sales forecasts, long-run outlook of top management, lines of authority for acceptance of new projects, criteria for accepting new projects, role of availability of internal funds, and other factors. From four to six "repeated interviews" with individuals within the firms were planned for this purpose. The Korean conflict altered plans somewhat, but the results of one "wave" of interviews were reported in mimeographed form.

Several tentative conclusions were reached on the basis

20 Modigliani notes that ex post data may fail to account fully for the relation of planned to realized investment because the behavior of the variables treated may have been anticipated in the original plan. Cf. Hart's conditions for fulfillment of expectations summarized in Chapter Two.
of initial interviews. First, the sales forecast (for the firms in this particular manufacturing industry) plays a central role in planning operations for a year into the future. This is true because of the seasonality of sales. Sales are concentrated near the planting and harvesting seasons, and are spread into a variety of products. For economical production (best use of plant, manpower, and inventories) firms usually try to produce at an even rate. This means that they often produce all of one article within a short portion of the year, often four to six months prior to the time they will be sold.

Second, the production schedule was found to be extremely important. Significant penalties attach to over and underproduction and a firm's cash position was found to be a key to the officials' attitude toward over and under-production.

Third, only a few firms engaged in long-term demand forecasts relative to the need for additional capacity. Post-World War II years did find some firms making formal plans for expansion, but this was mostly terminated by 1949. Cash positions seemed to be important, and where cash positions were felt to be weak, a close budgeting control was kept on expansion and a very short pay-off period required.

Fourth, little information was available on the origin and
basis of expectations. Sales forecasts were generally derived from the field sales force predictions, sometimes with the aid of national income and industry data, and were usually adjusted downward. The interviewers did not press this question very far so that it is not clear what information could have been obtained had more questions been turned in that direction.

In a recent study of investment decisions in Michigan firms, Katona and Morgan found sales and orders to be significant. Other important factors were technological changes forced by competitors, and long-run expansion in growing industries.21

In another study, Long called attention to the importance of expectations in the building cycle. He states that "among the many things we need to know is just how far into the future expectations normally extend and whether the length of this extension ever shows appreciable changes."22

The Merrill Project included a summary of the various types of data which already exist relative to investment plans and expectations. One of these sources is the Department of Commerce-Securities Exchange Commission canvas of firms registered


22 Long, Clarence D., Jr., Building Cycles and the Theory of Investment, Princeton University Press, 1940, p 52. A study of planning in electric power industry by Gort cited later in this chapter indicates that the horizon is always short.
with the Securities Exchange Commission and a sample of
unregistered firms. In this survey, firms are asked
concerning 1) the expected outlays for new plant and
for new equipment during the next quarter 2) the estimated
outlays during the current quarter and 3) the actual
outlays during the previous quarter. They also are asked
to estimate expected investment and expected sales for
a whole calendar year ahead.23

Friend and Bronfenbrenner studied some of this material
in connection with realization and non-realization of
planned investment. Using a follow-up, multiple choice
questionnaire they gained additional information con­
cerning why certain firms had realized, or not realized,
their investment plans.

They found that large firms are much more accurate
in their anticipations of actual investment and that large
scale investments are more accurately predicted than small
ones. They found also that changes in sales and earnings
had only a slight effect on realization of investment pro­
grams, but a major effect (one-half the cases studied) on
non-realization. However, contrary to what one would pre-
dict from, say Hart's analysis, liquidity position, working capital requirements, unfilled orders to sales had slight detectable effect on non-realization. Changes in availability of debt and equity financing were "quite unimportant" in non-realization.

The chief factors tending to increase investment beyond plans were changes in the supply of plant and equipment material, competitive conditions, and new products.24

In addition to the Department of Commerce-Securities Exchange Commission reports, there are several other efforts currently being made to gather information on plans, anticipations, and expected investment. For instance, Dun and Bradstreet survey about one thousand business executives monthly. They are representative of "larger, typical manufacturers, wholesalers, and retailers located throughout the United States."25 They ask merely whether their respondents expect their net sales, net profits, inventories, selling prices, and number of employees in a particular quarter of one year to increase or decrease compared with these figures for the same quarter of the previous year.

A McGraw-Hill survey asks "larger" concerns in manu-


facturing, mining, and transportation about investment plans for a few years in the future, expected increase in capacity, and policies followed in modernizing equipment. Fortune magazine polls an undisclosed sample of executives, asking them their estimate of future business trends and their own plans for the future.

Considerably before the "flurry" of surveys on expectations, Dice and Eiteman found that money payments made by firms were a response to the anticipation of money receipts. Like Angell's work (cited in the Appendix) their study did not specify the nature of the mental selection of encouraging and discouraging data. However, a study of bank balances of a sample of firms (small manufacturing, wholesale, retail) indicated that only the expectation of a favorable "clearing balance" could induce them to action by way of expenditures. Inferences from this study, and other evidence, indicate the inadequacy of the traditional quantity theory of money.

William O. Anderson found that firms were successful in responding to changes in the economic environment over time to the extent that they consistently maintained their


A study of investment planning in the electric power industry shows that "the importance attached to projections of future demand is directly proportional to their closeness to the present." Plans are made for about three years in advance, only the first two of which exert major influence. However, long-range plans (for about twenty years in the future) set the mental framework in which short-term plans are made.

The flexibility of investment plans even in this field of utilities is remarkable. Gort's study indicates that the companies are usually able to retrench very successfully on short notice. This is due to the fact that payment is usually made for capital equipment only in proportion to the amount completed, and cancellation is nearly always possible. Flexibility is not achieved in the design of the project so much as in the method of paying for it.

Another source which should be mentioned here is


30 Ibid., pp 90-95.
P. W. S. Andrews' Manufacturing Business. Parts of Chapter VI rely heavily on this work, and it is therefore summarized in that chapter.

E. A Theory of Investment

This section will be concerned with summarizing the contributions outlined in the preceding two chapters and with formulating a theory of investment based on these contributions. Some attention will be given to translating theoretical terminology into ordinary business terms.

This section was written prior to the writer's empirical work. It is recorded here approximately as first formulated in order to show in the concluding chapter how the statistical and empirical findings modify the initial theory.

In the course of an investigation one's ideas change in the light of increasing information. It is difficult, therefore, to know what the beginning hypotheses were and how they were modified from time to time in the course of the study unless some effort is made to leave their first formulation unchanged. The writer has not adhered rigidly to this plan but generally the following paragraphs are a record of his basic working hypothesis.

The most adequate generalization which can be made
concerning adaptation to uncertainty is that such behavior is motivated by a desire to maintain flexibility. Specific measures center around maintenance of liquidity, respectable balance sheet relationships, insurance, small inventories, unspecialized equipment, and so on. A. G. Hart is responsible for this insight. P. W. S. Andrews has noted the general tendency to have a normal reserve capacity, that is, some stand-by capacity for greater flexibility.

As entrepreneurs ponder investment commitments, which reduce their flexibility, they will be influenced by the reluctance of surprise and the temptation of gain. According to the analyses of both Shackle and Hart, the effect of pleasant and unpleasant unexpected revelations (surprise) is timewise asymmetrical. There are alternative statements of this principle. One expression of this hypothesis is that a creeping up of costs as orders expand, finally forces an entrepreneur to expand his plant and equipment. This is reflected in the "non-linearity" of the accelerator as noted by Goodwin. The accelerator is likely to achieve, during the first periods of its operation, a smaller amplification of income in the upward than in the downward direction, although in both cases the movement is discontinuous.

Investment considerations will include, of course, those
traditionally related to "corporation finance" although the perception of financial ratios is more important than their absolute value. They will depend also on technological considerations and engineering economics. And, like Duesenberry's ideal-type consumer, the entrepreneur will find that his behavior is not strictly reversible through time and that much depends upon his place in the social and industrial milieu. A firm's past growth and its position relative to other firms will mean that many of its decisions are more or less unique.

Yet, given these considerations, entrepreneurs will base their short and long-term expectations to a significant extent on their perception of certain short run factors, such as current sales, unfilled orders, overcrowded facilities, and inventories. Particularly important will be "surprise" where income is greater or less than expected, although individual differences among firms will likely be important in this regard. The dispersion of estimates, in particular the trend of this dispersion through time, will be important although an operational description of such a situation is difficult.

Once a decision has been made to expand, long-run

time and of varying amplitude, in the economy. Frisch examined
the theoretical structure of these oscillations, making use of
the principle of acceleration. Hicks, in the main, rejects
Frisch's theory on the ground that it posits an investment
coefficient of approximately one, which he thinks is in fact
unlikely.10

Samuelson incorporated on a theoretical plane the
acceleration and the multiplier principles into one analysis.11
He showed how the two principles combine to account for
oscillations. He did not show the conditions under which the
oscillations would dampen or explode.

Concurrently with Samuelson's theoretical work, Jan
Tinbergen subjected data on net investment in railroad rolling
stock and rate of increase in railway traffic to certain
statistical tests.12 He found that there is considerable
evidence for the operation of an acceleration principle. However,
the degree of association between the two variables was not
as large as might have been expected on theoretical considera-
tions. Tinbergen indicated that the degree to which plant is
being utilized significantly affects reactions of the accelerator
type. Further, the accelerator does not account for the "bunching"

10 Hicks, J. R., op. cit., p 7.

11 Samuelson, Paul A., "A Synthesis of the Principles of Accelera-
tion and the Multiplier," Journal of Political Economy, Vol. 47,
No. 6, December, 1939, pp 786-97.

12 Tinbergen, Jan, Statistical Testing of Business Cycle Theories:
A Method and its Application to Investment Activity, Geneva:
League of Nations, 1939.
anticipations (for example, predictions of secular demand) and technological requirements may be more prominent. However, these can be easily displaced by short-term considerations.32

Events proximate in time and similar will be considered causal and will be prominent in final decisions. Such a structuring of cognition will preclude "rational" reequipment policy envisioned by Terborgh; although it does not condemn such policy as a recommendation for a less uncertain world.

The hypothesis of this thesis is that binding investment decisions are something a firm attempts to steer around.33 Game theory and minimax solutions indicate that the final decision will be directed towards some point between the highest possible gain and the least possible loss, an intermediate situation.

How can this hypothesis, emphasizing the importance of

32 In a complete description of entrepreneurship attention should be given the concept of a "business personality." Keynes emphasized the role of "animal spirits" when he referred to "the nerves and hysteria of those upon whose spontaneous activity" investment depends. (General Theory, p 161) However, whether there is a personality type unique to the business, and particularly investment, world is not clear; or whether it is a universal trait in Western cultures is not clear. Henry Steele Commager in The American Mind refers to the peculiarly optimistic bent of Americans although he offers no critical test of this trait.

33 In the light of the factors making for cautiousness, certain homeostatic mechanisms (built-in stabilizers) in the economy become particularly important.
short-term considerations, be phrased so that there is some link between formal theory and business language?

The evidence of social psychology indicates that events on which business men make decisions will be recent, apparently causal, uncomplicated, and familiar. Terms and practices relevant to the formal theory of this section and the last two chapters are presented below.

The prominence of flexibility devices is illustrated by short pay-off requirements and attention to current ratios (for example, current assets to current liabilities). It is also perhaps indicated by the prominence given in investment manuals to the number of times net earnings exceed fixed charges on debt.

In terms of liquidity requirements as a device for promoting flexibility, useful connections with business experience are related to working capital requirements, inventory liquidation, cost of short-term funds, bank relations and reactions, calling of loans by banks, and quick assets to meet creditor or bank demands.

For surprise, business experience is important in connection with underestimation (or overestimation) of sales, income; with rush orders, sudden slowing up of sales (often seen in trade journal accounts), unfilled orders and inadequate plant capacity. Dispersion of expectations
is somewhat more difficult. Differing degrees of dispersion of estimates is reflected in statements referring to "confusion" in the market or within a firm, lack of consensus among decision makers, uniformity of opinion at trade meetings.

Statements like "short of . . . we expect," the best, the worst, maximum sales will be, and so on are related to the range of expectations.

In general other considerations related to attempts to maintain a flexible position consist of a cautious reequipment policy, aversion to debt financing, renting rather than owning equipment or plant, building up a large cash balance, unspecialized equipment, insurance, short pay-offs, unexcessive inventories, reserve capacity in design of plant and equipment, and diversified investments.

However, before further empirical studies can be reviewed and particularly prior to a description of the empirical work performed in this study, some brief and selective history of the rubber industry is required. Chapter Four will be devoted to a history of the rubber industry with special reference to investment decisions and reactions to change. 
Chapter IV

THE RUBBER INDUSTRY

A. Early History

Rubber has been known to western society since the discovery of the Americas. Christopher Columbus allegedly observed West Indians playing with "caoutchouk" balls. It was not commercially important, to the United States and England, however, until the early 1800's. Priestly by 1770 had given the substance its present name because of its obvious use in "rubbing out" pencil marks.

1. The writings of Columbus contain no direct information on rubber although one source notes that he claims to have seen "three mermaids standing high out of the water." The earliest Western record of rubber articles is found in D'Anghiera's Decades of the New World (1511). Recently discovered archeological evidence indicates the use of rubber in religious rites as early as 500 A.D. by Aztec tribes. Rubber Age, Vol. 61, No. 5, August, 1947, p 596. It is fairly certain that the South Americans of that time made rubber balls. Compare Wolf, Howard and Ralph, Rubber, New York: Covici-Friede, 1936, where it is also noted that these aborigines constructed hollow rubber balls from which they made "squirt guns" to be turned on each other during private parties - this being, the Wolf's speculate, an early instance of what has come to be known as the American sense of humor.

2. Fairly recent evidence indicates "extensive commercial use" of rubberized products in Mexico between 1785 and 1798. Rubber Age, Vol. 57, No. 4, July, 1945, p 458, report by Middle American Research Institute, Tulane University.

Some few rubber articles were manufactured in England and the United States early in the nineteenth century—particularly rubber boots and "mackintoshes."  

The major defect of rubber goods prior to 1839 was their sensitivity to temperature changes. Charles Goodyear is generally credited with having devised in that year a process of vulcanization during which crude rubber becomes immune to temperature change— that is, not hard in winter or sticky in summer.  

4. Precise data on the size of the industry prior to 1839 are difficult to obtain. The 1849 Census of Manufactures is one of the first official sources of information in this industry. In 1849, thirty-six establishments employed 2000 workers in producing $3,000,000 in rubber goods. The United States had imported some shipments of rubber shoes prior to the discovery of vulcanization; in 1826 the value of rubber shoes imported from Brazil stood at $3,000. Cf. Rubber Industry of the United States, 1839-1939, P. W. Barker, Department of Commerce, Government Printing Office, 1939.  

5. India Rubber World, Vol. 62, No. 4, July 1, 1920, p 633. Rubber is not easily defined because what corresponds in common usage to rubber is merely a particular state of a hydro-carbon compound, whose useful properties depend upon a peculiar molecular arrangement, not upon the ratio of carbon to hydrogen. Rubber (C₉H₈) exhibits, as does all matter, different properties at different temperatures and/or pressures. Goodyear's discovery was that crude rubber when heated with sulfur becomes immune to change over a wide range of temperatures.  

As with many other discoveries, there is some question whether the person generally credited with this achievement is in fact the person to whom credit is due. Thomas Hancock of England claimed to have discovered the process about the same time Goodyear applied for a patent. This led to considerable litigation, but critical opinion (in the United States) credits Goodyear with the process. For example, see the careful study of Charles Goodyear's life by E. G. Holt in Rubber Age, Vols 43-44, 1938-9.
Goodyear's discovery set in motion an expanding demand for rubber. The major source of supply at that time was the uncultivated Hevea tree in the Amazon river valley of Brazil. Imports of crude rubber from this, and other, sources increased through the years.

Table 4-1

Value of Crude Rubber Imports

United States, Selected Years

(Thousands of dollars)

<table>
<thead>
<tr>
<th>Year or Yearly Ave.</th>
<th>Value of Import</th>
</tr>
</thead>
<tbody>
<tr>
<td>1860</td>
<td>1,427</td>
</tr>
<tr>
<td>1870</td>
<td>3,460</td>
</tr>
<tr>
<td>1871-1880</td>
<td>5,695</td>
</tr>
<tr>
<td>1881-1890</td>
<td>13,262</td>
</tr>
<tr>
<td>1891-1900</td>
<td>21,135</td>
</tr>
<tr>
<td>1901-1910</td>
<td>17,755</td>
</tr>
<tr>
<td>1911-1915</td>
<td>82,736</td>
</tr>
<tr>
<td>1916-1920</td>
<td>192,149</td>
</tr>
<tr>
<td>1921-1925</td>
<td>192,922</td>
</tr>
<tr>
<td>1926-1930</td>
<td>294,428</td>
</tr>
<tr>
<td>1931-1935</td>
<td>74,573</td>
</tr>
<tr>
<td>1936-1940</td>
<td>206,312</td>
</tr>
<tr>
<td>1941-1945</td>
<td>148,694</td>
</tr>
<tr>
<td>1946</td>
<td>232,800</td>
</tr>
<tr>
<td>1947</td>
<td>316,740</td>
</tr>
<tr>
<td>1948</td>
<td>309,137</td>
</tr>
<tr>
<td>1949</td>
<td>240,312</td>
</tr>
<tr>
<td>1950</td>
<td>458,512</td>
</tr>
</tbody>
</table>


Data on imports are not readily available prior to 1860.

However, it seems likely that since industrial applications of Goodyear's discovery were not made until 1844-5, imports were not
substantial before the 1860's. The Civil War and the post-war development gave rubber footwear, and rubberware in general, a significant sale for the first time.

Obviously, the most important change in demand for rubber was associated with the growth of the automobile industry. However, prior to the predominant importance of the automobile, rubber footwear constituted a significant article of manufacture. For example, in 1871 "rubber boots and shoes were manufactured in this country to the amount of $8,000,000." Mechanical rubber goods were next, then rubberized and waterproof garments, then druggists' sundries.

The pneumatic tire, whose practical use is dated around 1888 turned the attention of rubber firms to the manufacture of carriage and bicycle tires. This development set the stage for the introduction of the horseless carriage and the rapid growth of the tire industry.

6. Reliable sources assert that the California Gold Rush in 1849 brought increased demand for rubber boots and rain coats. cf. Rubber Production and Manufacturing, Department of Commerce by P. W. Barker, 1939.


1. Volatile Price of crude rubber prior to World War II.

The price of crude rubber has varied from 2 1/2¢ to $3.06 per pound during the last 75 years.\(^8\) This is typical of price behavior in other primary industries. These fluctuations in price stem, of course, from a combination inelastic demand and supply of rubber. Prior to the 1940's there was no substitute for rubber and rubber is a small percentage of the price of an automobile. These factors made for an inelastic demand. On the supply side, small holders tend to behave so as to produce a negatively sloped supply curve. This, coupled with the technological necessity of waiting five years from planting to tapping time, has made for inelastic supply.

\(^8\) Prior to World War II, United States industry was entirely dependent on foreign supply, first from Brazil, later Southeast Asia. When Brazilian speculation (government sponsored) ran the price to over $3.00 in 1910, plantation rubber became profitable and Sumatra and other parts of the southeastern portion of Asia soon had rubber plantations controlled by English and Dutch nationals, and native-small-holders. In 1910, 88% of the world's rubber came from the Amazon, while now no really significant amount of rubber comes from that source. Cf. Price, Willard, The Amazing Amazon, New York, John Day Company, 1952. Fortunately, Sir Henry Wickham had succeeded in "smuggling" a few Hevea seeds out of Brazil in 1876, taking them to London, or perhaps plantation rubber would not have been possible. Cf. Alderfer, E. B., and Michl, H. E., Economics of American Industries, McGraw-Hill, 1950, p. 303.

For an excellent (but probably overly dramatic) account of this escapade and the plight of native labor in Brazil during the nineteenth century see the Wolf work. Rubber Age noted in 1940 that Sir Henry was "cleared" as a smuggler. Records now available show there was no legal restriction on exports of Hevea seed from Brazil in 1876. Cf. Rubber Age Vol. 46, No. 1, p. 382 March, 1940.
Probably the situation has been, from the theoretical point of view, an inherently unstable one, although empirical demand and supply curves have not been derived.\(^9\)

The underlying conditions of supply and demand, plus government attempts at regulation from time to time (on the part of Brazil first, and later England) have made for wide fluctuations in the price of rubber. Attempts to corner the market have reflected this situation. United States Rubber Company was founded mainly to corner the India rubber market in 1892.

Rubber manufacturing companies have been subject to great losses on inventory. For years this was one of their chief problems. A chart of crude rubber prices and profits in the rubber industry shows that there is a very close association between these two variables. Further, it seems very likely that this was one of the reasons for the concentration of production in a few firms. Small firms could not weather the financial difficulties accruing from changes in the value of inventories.\(^10\)

\(^9\) On the conditions for an unstable equilibrium see Samuelson, P. A. Foundations of Economic Analysis. On the underlying supply and demand conditions in the rubber industry see Alderfer and Michl, Economics of American Industries or any good economic geography.

\(^{10}\) As late as 1938 a trade journal editorial remarked that because of the high ratio of raw material costs to total costs ..... inventory management is often more important than sales volume in determining ..... profits." Cf. Rubber Age, Vol. 43, No. 5, p. 302, August 1938.
On many occasions, survival in the industry apparently turned on purely financial resources. 11

2. Concentration of production.

As with other manufacturing industries, charges of violation of the Sherman Anti-Trust Act appeared around the turn of the century. United States Rubber Company was accused of being a vertical trust. The company was, in fact, an early giant among rubber companies but it never effectively eliminated competition.

11. Since successful hedging activities are capable of minimizing inventory losses, question might well be raised why companies did not take this means of avoiding such loss. Probably the main reason is that individual purchases were required to be so large (a supply adequate for at least four months operation was standard procedure) that the rubber market was too "thin". For successful hedging, a substantial number of speculators must stand ready to act on the basis of small changes in price. The Rubber Exchange of New York was not formed until 1926 and trade journal articles as late as the early 1930's show that rubber manufacturing firms did not generally take advantage of the opportunity to reduce risk on forward commitments. Forward trading of rubber had been centered in London prior to 1926. The Rubber Exchange of New York published in 1926 a booklet to explain "hedging". See Rubber Age Vol. 18, No. 10, pp. 331-2, February 25, 1926, also Vol. 19, No. 7, July 10, 1926.

Further, only a perfect hedge (which requires a predictable relationship between future and spot price) would completely eliminate inventory loss; and this was not always true of the rubber market. And inferior grades of crude rubber were sometimes delivered, in earlier years, on contracts calling for higher grades. Cf. the article by Charles O. Hardy on "Hedging" in Encyclopedia of the Social Sciences, Macmillan Company, New York, 1932.
of replacement expenditures, and the rate of profits is a better explanation of investment changes, in terms of correlation coefficients, than is the acceleration principle.

By induced investment Hicks means investment occurring as a response to a change in total (real) income.\textsuperscript{13} A central concept in the Trade Cycle is the investment coefficient, defined as the ratio of induced investment to changes in total income.\textsuperscript{14} This coefficient is the key to the structure of the oscillations. If the investment coefficient is greater than the "middle point" (unity), the oscillations will be explosive. If the investment coefficient is less than this amount, the oscillations are likely to be damped; while if the coefficient is one, they will be constant. Hicks postulates an investment coefficient "above the fiddle point" leading to explosive oscillations.\textsuperscript{15}

In fact, of course, oscillations are not unlimited in

\textsuperscript{13} Cf. Ulmer, M. J., "Autonomous and Induced Investment," American Economic Review, Vol. 42, No. 4, September, 1952, pp 587-589. Ulmer suggests "warranted" investment be used to connote the amount of investment needed to restore the "most profitable capital-product" relationship after an increase in income; and that "contingent" investment connote that activity resulting from anticipations. The present study suggests, however, that the more traditional categories are operationally more useful.

\textsuperscript{14} Hicks, J. R., \textit{op. cit.}, p 68.

\textsuperscript{15} \textit{Ibid.}, p 91.
The industry came to be characterized by the dominance of a few major firms: United States Rubber Company, Goodyear Tire and Rubber Company, the B. F. Goodrich Company, Firestone Tire and Rubber Company, and to some extent General Tire and Rubber Company.  

The predominant role of a few firms did not vitiate competition in the industry. Price competition was characteristic of these firms. This was extremely disadvantageous in a situation which, from a theoretical point of view, should have produced price agreements among the oligopolists. Probably the drive for utilization of excess capacity, the volatile prices of crude rubber, and the particular personalities of the leaders of some firms contributed to this policy.

12. Fisk, Ajax, Miller, Hood, Kelly-Springfield, and Seiberling have been rather important at various times. Goodrich acquired Hood Rubber Company in 1929, after previously buying a controlling interest in Miller. Goodyear acquired Kelly-Springfield in 1935 (in an ironic twist of history since Kelly-Springfield had initially sued Goodyear for infringement of patent in 1901 and almost eliminated that company). Cf. Roberts, The Rubber Workers, New York: Harper and Brothers, 1944, pp 333-4. Roberts attributes the Kelly-Springfield failure to "inefficient management," technological lags, and the price wars of the 20's. United States Rubber obtained controlling interests in Samson Rubber Company, first rubber company on the West Coast in the 1920's after Samson had built an eight million dollar plant in Los Angeles. The United States Rubber Company also bought the Gillette Rubber Company. Price wars, advertising costs, capital requirements (especially for crude rubber inventories which were subject to wide price fluctuations), and the depression beginning in 1929 contributed to the demise of other medium-size firms. Rubber Age reported in October, 1924, that "one out of every five tire companies in the United States since the World War ended have gone into bankruptcy" the principal reason being lack of capital.
2. Productivity and Technological Change.

Technological changes have been significant in the rubber-tire industry particularly, and to some extent in the rubber goods industries generally. The results have been increasing productivity per worker, longer lasting tires lessening the replacement sales market, lower prices, and a reduction in the number of workers employed in the industry. While technological change has not been as rapid as in some industries (Walton Hamilton notes that equipment in the rubber industry has a "taint of immortality" as compared with equipment in the petroleum industry) it has been steady and a certain amount of plant expenditures have been forced on firms for this reason. Technological change, of course, occurred at a very rapid rate in the early history of tire production.

The improved quality of tire and increased productivity per worker have both aggravated and brought about the persistent problem of unused capacity, which was so closely associated with the price wars of the 1920's and 30's.

The automobile industry accounted, in 1932, for five-sixths of all crude rubber consumed in the United States. It is not surprising, therefore, that the drop in production of new cars in the early thirties and the increased durability of tires (affecting the important replacement sales market) made producers anxious to maintain the volume of their sales even at the cost of ruinous price wars.

The goal of plant utilization through increased volume of sales has in certain conflicting forms of marketing in the tire industry. Of the two general types of sales, replacement sales are much more important than original equipment sales. Original equipment sales to car manufacturers constitute a minor portion of total sales and the auto firms exert so much pressure for low prices that it appears doubtful that original equipment sales have been profitable.

14. Encyclopedia of the Social Sciences, Vol. 13, p. 454. The rubber industry has been almost completely tied to the auto industry. One reason for over-extension of plant in the rubber industry was the effort to keep up with the automobile industry which produced only 4000 cars in 1900 as compared with 2 million in 1920 and nearly 5 million in 1929. Cf. Borland, Hal "80 Million Americans on the Move" New York Times Sunday Magazine, p. 20, August 24, 1952.


at all. Commercial accounts (fleets of automobiles) have likewise been able to exert strong pressure on the rubber firms. And the large retail houses (Sears, Montgomery Ward) appear to have been in a very favorable position with respect to the rubber firms, thus causing large price concessions in the important replacement sales market.

The result has been an industry characterized by price cutting where the structure of the industry would prescribe price agreement. Further, the number of producers in the industry is probably fewer than is "economic"; because only large firms can advertise (i.e., allocate selling expenses over a large volume) and survive losses occasioned by price cutting in an industry where the demand curve for the individual firm is probably a "kinked" one. There seems to be no evidence that returns to scale would warrant such concentration of production. What little data are available indicate that constant returns to scale is a more adequate description; although Akron plants were probably at a


18. P. W. Litchfield, head of Goodyear Tire and Rubber Company said in 1935 that the problem of tire prices and sales is the "increase in the number and variety of tire merchandising outlets combined with the shrinking number of units annually sold." Rubber Age, Vol. 38, No. 1, p. 38, October 1935.
stage of decreasing returns prior to World War II.\textsuperscript{19}

In summary, the industry was characterized prior to the Second World War by: volatile raw material prices, concentration of production in a few firms, dependence on the automotive industry, and technological improvements increasing productivity and tire-life leading to cut-throat price competition for utilization of surplus capacity.\textsuperscript{20}

\textbf{C. 1839-1900}

For the purposes of this thesis, it will be useful to examine certain time periods. The period 1839 to 1900 was devoted primarily to the production of rubber footwear, mechanical goods, waterproof garments and druggists' sundries. In the latter

\textsuperscript{19} The Bureau of Foreign and Domestic Commerce in a Special Circular 3502, 1933, p. 14, states that "Granting an identical material, labor costs per unit, and the same management, a plant which at capacity produces 1000 tires a day in two 6-hour shifts, is about as economical to operate as a plant which produces 10,000 to 20,000." The Bureau felt that plants producing upwards of 50,000 tires a day, were probably producing at a higher per unit cost.

\textsuperscript{20} See the unpublished doctoral dissertation by Beights, David M. \textit{Financing American Rubber Companies}, University of Illinois, 1932. Beights characterizes the industry as "decreasing cost" but this is probably incorrect from the point of view of economic theory. Relative to money capital requirements it possibly is a "decreasing cost" situation.
part of the nineteenth century manufacturers were turning to bicycle and carriage tires, particularly with the advent of the pneumatic tire, around 1888. New England was still the control rubber manufacturing area.

The United States Rubber Company, incorporated in 1892, was an amalgamation of several companies originally formed by Charles Goodyear. The organization of the United States Rubber Company represented an effort to control the supply of crude rubber and a major portion of the production of finished goods. U. S. Rubber manufactured a third of American rubber footwear and most other soft rubber goods under a subsidiary, Mechanical Rubber Company.21

This "rubber trust", for several reasons, never succeeded in monopolizing the manufacture of rubber goods. First, entry requirements were apparently not formidable at that time, except for patent limitations. The presence of small rivals seems to have characterized the industry during its whole history. Second, while two colorful leaders of United States Rubber Company guided the price-cutting, it was apparently not carried on for a sufficient length of time.22 Third, the company found itself in an unsatis-


22. These leaders were among the colorful "Captains of Industry" of that era - Charles R. Flint and Samuel P. Colt. Cf. Flint, C. R., Memories of an Active Life.
factory position due to its internal financial arrangements. Amalgamation and plant expansion were mainly financed out of borrowings, while dividend payments were maintained. The fixed charges incurred from borrowing, and the absence of cushioning reserves caused by continued dividend payments, placed the company in difficult financial straits.

By 1899 solid tires for carriages were manufactured in the United States with a total value of $4,000,000; bicycle tires, $7,500,000. In this year, Flint organized the Rubber Goods Manufacturing Company, a subsidiary of the United States Rubber Company, which aimed at a monopoly in tires, both carriage and bicycle. However, tire manufacture was not yet as important as the rubber boot and shoe industry.

The B. F. Goodrich Company was founded in Akron, Ohio, in 1871, for the production of mechanical rubber goods. The Goodrich Company came to Akron when Dr. B. F. Goodrich, a New York physician, chanced upon a brochure sent out by the Akron Board of Trade inviting industry to that city. Dr. Goodrich had gained control of a rubber firm in Hastings on Hudson, New York, through various real estate transactions. In an effort to avoid the New England competition, where the industry was then centered, and perhaps in an effort to tap new markets and new labor sources, Goodrich accepted the generous offer made by Akron city and trade groups.
It is reported that the Goodrich firm encountered numerous financial difficulties during its first decade in Akron. This was the period, of course, of the panic of 1873 and generally declining prices. In 1881 sales of hose and mechanical rubber goods totaled $300,000 and "the first addition to the tiny original plant was built."\textsuperscript{23} By 1892, 700 were employed at Goodrich and sales were more than one million dollars. In 1894 Goodrich entered the manufacture of solid rubber buggy tires for the Rubber Tire Wheel Company.\textsuperscript{24} In 1901 Goodrich sales were more than $5,000,000. By 1894 interests from the Diamond match concern had formed the Sherbondy Rubber Company (later Diamond Rubber) adjacent to the B. F. Goodrich plant and both engaged in the manufacture of rubber tires for bicycles and buggies. The two firms cooperated closely with each other from that date and Goodrich purchased the Diamond firm in 1912.

\textbf{P. 1900-1905}

In the period 1900-1905 several important Akron companies actively entered into the production of automobile tires. It is difficult, however, to account for the localization of the new industry in Akron. Far from crude rubber supplies, on no major

\textsuperscript{23} Wolf, \textit{op. cit.} p. 405.

\textsuperscript{24} Ibid, p. 418.
body of water, with labor recruited from West Virginia and Kentucky, and water inadequate supplies these companies made Akron the rubber producing center of the world. Aggressive and efficient management, in a favorable city environment, taking advantage of the fairly close and booming auto industry probably account for the industry's centralization.25 The rate of expansion of the automobile industry hardly left time for thoughts of efficiencies to be achieved through decentralization, at the critical growth period.

When the Seiberling Empire Reaper and Mower Company failed in 1896, J. F. Seiberling and his son, Frank A. Seiberling, formed the India Rubber Company using one of the old Empire buildings.26 Charles Randolph Flint's Rubber Goods Manufacturing Company took over this firm in 1898 but the Seiberlings then formed another company,27 the Goodyear Tire and Rubber Company.


27. Goodyear's biographer, Hugh Allen, does not mention this early venture in rubber, rather dating the Seiberlings' rubber interests at 1898.
Goodyear had profits in 1898 of $35,000 on a paid-in capital of $90,000. Two patents quickly got the new enterprise into difficulties. In 1896, a patent had been issued to Arthur W. Grant and assigned to the Rubber Tirewheel Company of Springfield, Ohio, for a method of fastening tires to rims. A Tillinghast patent on pneumatic bicycle tires was the means of limiting production of bicycle tires by new companies.

Goodyear made a "departure" from the Grant method, found their profits held in escrow in a suit brought by the owners of the patent. Meanwhile Goodyear operated with income derived from the sale of bicycle tires, on which they were also sued for infringement of patent rights. The Grant case was decided for Goodyear in the United States Circuit Court of Appeals in May 1902, thus assuring the existence of what was to become the world's largest manufacturer of rubber tires. This was, incidentally, an important decision for Firestone also since they were able to supply clinchers without fear of patent infringement.

28. One source indicates the Goodyear beginning was financed in the following manner: "Four promissory notes of $2,500 each and a down payment of $3,500 . . . borrowed from a friend . . . an additional $43,500 by sale of stock". By 1900 the capitalization was $300,000. Roberts, Harold S., The Rubber Workers, p. 193.

their explosive nature. Hicks introduces, therefore, the concept of a constrained cycle and attempts to define the limits on the oscillations when they are of an internally explosive nature.16

The Trade Cycle is an extremely important contribution to the literature on the business cycle. It is strong support for the contention that investment expenditures play a unique role in an economy of a generally enterprise nature. There are some limitations on this study, however.

First, statistical tests recently made of Hicks' hypothesis, using available American data, indicate that profits, lagged less than a year, correlate with investment more closely than changes in total income.17 This is the conclusion Tinbergen reached in his statistical testing of the role of the accelerator in the business cycle.

Second, statistical evidence indicates that an investment coefficient greater than one is unlikely for the United States.18

16 Ibid., pp 65-94. These limits are a "real" ceiling in the upward direction and the technical problem of disinvestment in the downward direction. The "real" ceiling makes the downturn inevitable because induced investment must conform to these limits. The accelerator in a slump becomes effectively a decrease in autonomous investment.


Harvey Firestone had founded the Firestone Rubber Tire Company in 1896 in Chicago for the purpose of selling tires and "attaching" them to rims. The Rubber Tire Wheel Company bought Firestone's company and made him an official of their company in 1898. Firestone shortly thereafter moved to Akron to head the tire department of a drill manufacture there. By 1900 Firestone and an Akron associate, the owner of a new fastening device for attaching tires to rims, had founded the Firestone Tire and Rubber Company. Firestone and his associates thus entered the market to sell a new tire, one featured as "absolutely solid, no holes." At first Firestone did not engage in manufacture, but was a buggy tire jobber. In 1902, however, he began manufacture of solid tires, employing twelve men. By 1906 he was defying the United States Rubber "Clincher Association" in supplying Ford with clincher type tires, having produced a pneumatic tire by 1906.

The period 1900-1905 is significant as the period during which these major firms were founded and experienced their first growth in the automobile tire area. The industry was, as can be seen from the early history of these firms, one of competition along technological lines from the beginning. Goodrich, as was noted earlier, entered into the production of tires during this period, and the United States Rubber Company began to produce tires in 1899.

The Firestone Tire and Rubber Company was recapitalized in 1905 to provide for plant expansion since "the old capital had been insufficient to swing the large volume that the company had achieved with 130 employees." The company had developed rapidly in promoting their new tire and the volume of business had necessitated expansion. (See appendix to Chapter VI for a further account of Firestone's early growth.)

E. 1905-1920

The next period was also one of rapid expansion. These were the years during which the automobile was demonstrated to be of such great significance. There were many developmental problems. Pneumatic tires were found to be practicable for automobiles. An innovation had to be quickly taken advantage of, because other firms would quickly develop a similar change. Goodyear experienced this in developing the "straight side" pneumatic tire which possessed certain advantages over the old "Clincher," a type controlled by United States Rubber Company. It is generally conceded that this was a significant innovation though there was some question whether they were the only company to develop such a tire.


32. Firestone claims to have developed a similar tire, Lief, op. cit., p. 12. The record however, seems to be that Goodyear was the first to advertise such a tire nationally in the magazines of that time.
Goodyear claims to have been successful in exploiting the straight side tire (1907-9) and introducing a new cord tire. Floor space grew from 40,000 feet in 1908 to 5,000,000 in 1920. The automobile industry was growing tremendously during this period. Litchfield later characterized 1908-1920 investment as expenditures designed to "grab the market".

"... with an improved tire in our hands, the need for saving time became imperative. We could have the market to ourselves for a short time only. If we could not produce the tire fast enough with existing buildings and machines we must build new buildings, buy or design more and better machines ... we paid more for our buildings and machinery than we would have done had we been willing to wait. Time literally was money to us ... those were the driving days of a driving industry."

Firestone's biographer claims that "by late summer 1905, Firestone had the first practical straightside pneumatic tire." Early in 1906 Ford placed an order for 2000 pneumatic straight side tires with Firestone. Prior to obtaining this order, Firestone "his confidence in high key ... expanded the company's facilities both to accommodate the increasing volume of solid-tire sales and to manufacture pneumatics ... and plant capacity trebled."

34. *Lief, op. cit.*, p. 27
To fill the Ford order, heavy commitments had to be made for rubber, fabric, rims, and metal parts since Firestone had designed a tire to fit his own rim. However, since Ford and Firestone lacked, at that juncture, distributing centers for replacements, Ford required Firestone to supply clinchers rather than straight sides. Firestone, refused a license by the Clincher Association, manufactured them without one, and "orders came in fast." 36

The Diamond Rubber Company (which had always cooperated closely with Goodrich and amalgamated with that firm in 1912) obtained control of the English Silvertown cord tire in 1910. Diamond found that they had to advertise this innovation highly and sell the tire quickly. 37

Firestone, unable to obtain rims from established firms, undertook to build his own demountable rims in 1909. 38 This, according to Firestone's biographer, has throughout the history of the firm continued to be an important aspect of its operations. In 1909 the rim division used 12 tons of steel; in 1914 12,000 tons. 39 Firestone offered its first "Non-Skid" Tire in 1908.

36. Lief, op. cit., p. 32
37. Wolf, op. cit., p. 426
38. Lief, op. cit., p. 41
39. Ibid., pp. 44-5
In 1910 Firestone reorganized under an Ohio charter, started work on a half-million plant expansion and sold 10,000 sets of tires to Ford Motor Company. In 1916 a new story and new wings were added to the plant and ground broken for Plant 2. And World War I assured full production until 1920. This was typical of growth in the rubber firms during this period as the population of Akron grew from 42,923 in 1900 to 69,067 in 1920.

Investment during this period was influenced mainly by the secularly expanding demand accompanying automotive development and innovations presenting opportunities to "grab the market".

F. 1920-21

The rubber companies had many difficulties during the 1920-21 recession. It is an extremely important period for investment decisions (being filled with "surprise") thus warranting close investigation of its narrative sources.

Goodyear's biographer says:

"Depression . . . started that summer in a sudden slowing up of sales, cancellation of orders; grew to cataclysmic proportions in succeeding months. Buying dried up. People quit buying tires, patched up their old ones and made them do.

Material prices did fall . . . with staggering swiftness and force. Goodyear's inventory of crude rubber dropped in value for a total of $50,000,000 in a single 12 months starting May 1920.

Cash reserves were rather narrow . . . Goodyear even in normal times had difficulty in financing its current needs.

Rubber brokers, fabric mills and machinery men began swarming into Goodyear's doors demanding their money. The banks were calling loans rather than making new ones. 40

40. Allen op. cit., pp. 53-5, italics supplied.
Firestone's biographer reported that: "Inflation rode the buying wave. Manufacturers in all lines made heavy commitments for the year (1920). In the spring of 1920 the repercussions began. Harvey Firestone . . . saw that business was 'slowing down too rapidly'. Farm prices cracked; industrial buying stopped; from everywhere came reports of retailers' cancellations of orders; consumers went on strike" . . . Cables from Akron invaded vacation (Firestone was in Europe) 'sales and collections not encouraging' . . . notes to pay off . . . material kept arriving on contracts that had been signed for record amounts, Inventories were already excessively large."41

Firestone cut prices one-fourth. By this technique, and consumers' response, Firestone "came through 1920 sound and unfettered."42

41. Lief, op. cit., p. 127
42. Ibid., p. 130
Several areas of these accounts are significant. First, inventory uncertainties are clearly evident. This is a risk which plagued rubber firms from the 1870's on.\textsuperscript{43} It was necessary to buy rubber four months ahead, and firms were often caught with high-priced inventories when prices dropped.\textsuperscript{44}

\textsuperscript{43}. The first attempts at a "caoutchouc corner" occurred in 1878 and 1881 when a Portuguese merchant ran prices from 40\$ to over one dollar. American manufacturers withdrew from the market and forced the price down again. Wolf, pp. 214-5. Prices went as high as 87\$ again in 1891. The United States Rubber Company tried to obtain control of the supply of crude rubber in the 1890's.

However, in 1905-6 the Brazilian government pegged the price (with the aid of private speculators) at over $1.25, the high being $1.50. This started the movement to plantations in Sumatra and Southeast Asia, and when in 1910, Brazil ran the price from 70\$ to $3.06 she delivered her own \textit{coup de grâce}. The \textit{India Rubber Journal}, an important trade publication, stated in April, 1911, that "wild rubber is doomed - it is just a matter of time - but to prematurely fix the date of execution is to promote strenuous opposition on the part of the doomed. Meanwhile . . . she (Brazil) produces four-sevenths of the total world's supply."

Volatile rubber prices (and low prices at that) led the British to a restriction scheme (Stevenson plan) in the 1920's. London Rubber Brokers knew that once full world production was restored after World War I heavy pressures would be exerted to lower rubber prices. (\textit{Rubber Age}, Vol. 19, No. 2, p. 94, May 10, 1926). By July 1925 the price was $1.21 and Harvey Firestone began to emphasize his contention that Americans should produce their own rubber - although other American firms did not back him up very strongly. Dutch small-holders drove the price back down, since they did not participate in the restriction scheme, while Americans were exercising themselves in print.

However, in the 1930's even the Dutch cooperated in a restriction scheme, which, though it did not completely control the small-holder, yet resulted in a rather stable price arrangement during that period.

\textsuperscript{44}. \textit{Rubber Age}, Vol. 11, No. 1, p. 52, April 25, 1922, on the need for a four months supply of crude rubber.
Hedging was not possible apparently. Inventory behavior during this period and others prior to World War II (when synthetic reduced this risk) should provide information on uncertainty reactions.

Second, working capital provisions seem to possess some unique characteristics for the rubber industry during this period, and others as well. "Cash reserves were rather narrow" was the expression used by Goodyear's president in 1920. Goodyear, however, was the company of the bigger firms, encountering the most difficulty in 1920, partly because of their rate of expansion.

One writer claims that a significant portion of the troubles of the rubber industry stems from their financing techniques, which led to a shortage of working capital. At this time (1921) financial interests assumed great prominence in Goodyear and Fisk and threatened other rubber firms. Dillon, Read and Company took over Goodyear, although other large firms escaped complete acquisition.

The United States Rubber Company was engaged in a thirty million dollar expansion program when the 1920-21 recession occurred. The company attempted to continue this program by

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45. Beights, op. cit.


47. Wolf, op. cit., p. 446.
issuing $20,000,000 in 7\% notes. It was impossible, however, to
ignore the depression and in 1921, when Charles Seger replaced
Samuel Colt as head of the firm, inventories were written down,
prices cut, and short-term bank notes paid off.

Expansion was going on early in 1920. Buildings were being
constructed, a good year was generally predicted. Then depression
hit quite suddenly. And consistent with the thesis of Hart and
Shackle, the investment depressing effects were immediate.

After a short time, however, investment increased again and
the time lag in some firms was not outstanding contrary to Hart and
Shackle. What were the factors which caused plant expansion to
come about? Goodyear apparently delayed longer than Firestone,
for example, where since "the new year (1922) went very well . . .
the time seemed ripe to resume construction of the Canadian plant,
long delayed."48

Information on the process by which prospects brightened in
1921 should contribute to our understanding of selective awareness in
investment decisions.

The years 1921-1929 were characterized by an increase in plant capacity, an increase in sales, the emergence of cutthroat price competition, more durable products, and continued fluctuation in crude rubber prices. It was a boom period in Akron, but one which found total employment in rubber less than half the 1919 peak and net earnings of less than 2% on tangible assets for the period as a whole, and marked change in the forms of marketing automobile tires.

Plant and equipment in the rubber firms increased by 50% in the period 1927-29 which Reynolds has characterized as a period of "miscalculation of demand".

This is the period during which price competition and increasing productivity resulted in the elimination of smaller firms and less than average earnings for the larger firms. In 1920 average tire prices were $45. By 1928 they were $18.75. The Stevenson Plan retarded the drop in prices (raising prices from $25 to $29 in 1925) but could not stop the decline. Tire prices were $10 or less in the years 1932-6.

49. See Walton Hamilton, Lloyd Reynolds, and other previously cited.
Third, the mechanical nature of Hicks' model begs the question of firms' understanding of income changes. This study is concerned with the problem of explaining the meaning of income and profit increments to individual firms. Firms will react differently to profit and/or national income changes depending on their understanding of these changes. The "mental set" or filter which conditions their view of recent changes will determine their future behavior. Few solutions have been offered to the difficulties raised by mechanical models, although Hicks is aware that "financial pressure" which makes it difficult to carry stocks during the downswing of the cycle will generate a psychological speeding up of the downward trend. He further notes that "discovery of a new investment opportunity is . . . likely to be followed by a stream of net investment with the characteristic time-shape of the hump and the tail."^20

Fourth, Hicks' model is somewhat inadequate in terms of its internal consistency. Fisher argues that the restrictions which Hicks places on the operation of the accelerator "have the effect of making his theory a non-linear one."^21 The model presented in the Trade Cycle does not clearly show

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19 Hicks, op. cit., pp 117-8.
20 Ibid., p 121.
The history of tire prices during the 1920's reflects 1) the increasing productivity of the industry, 2) the effects of the Stevenson Plan\(^5\) and 3) rivalry among the large producers.

Prominent in the price rivalry of the period is a contract between Sears, Roebuck and Goodyear, initiated by the two firms in May 1926. Probably it is accidental that this was the first such contract, because there was a strong drive for volume and utilization of capacity accompanying plant expansion and increasing productivity. However, it is the contract which was brought under investigation by the Department of Justice. It is a benchmark.

\(^5\) The Stevenson Plan was authorized by Great Britain in 1922 while Winston Churchill was Secretary for the Colonies. It was designed to restrict the production of rubber by placing a sliding tax on exports from British territories. Specifically, the plan provided that when the average price of rubber during any three-month period remained at the 1920 base level, 60% of the exports were to be taxed at the minimum duty. When average price in the London market during the previous three months increased, the percentage of rubber exportable at the minimum duty increased. The time lag introduced by taking a prior three-month base tended to accentuate price variations, though generally the initial effect of the plan was to raise crude rubber prices. The Dutch small-holders' production, use of reclaimed rubber, a buyers' pool in New York, and restraint on the part of American firms worked against high prices. Restriction ended officially October 31, 1928 and a New York Buyers' pool was wiped out with large losses.
in the history of price competition in the rubber industry and the Federal Trade Commission hearings provide much valuable information on this aspect of the industry.\(^\text{51}\)

F. A. Seiberling in an address to the Rubber Manufacturers' Association said that the rubber people were acting like "wolves in the jungle" in their price wars. *Rubber Age*, Vol. 26, No. 44, Pp. 425-6, January 25, 1930.

Goodrich Tire and Rubber Company and U. S. Rubber Company signed contracts with Standard Oil and Montgomery-Ward and Company respectively, and Firestone opened his own chain of stores. There is some evidence that Sears exerted considerable control over Goodyear, because Goodyear was never certain that a rival would not receive the business. Rivalry among the few major firms produced such low prices that even DuPont, controlling both General Motors and United States Rubber Company,\(^\text{52}\) found it profitable to let other rubber companies subsidize them in production of tires.

\(^{51}\) The record, for example, indicates that Goodyear gave credit adjustments (FTC evidence shows that Sears considered them "rebates") to Sears at the end of each year and that cost accounting techniques worked out between the two companies usually gave the advantage to Sears. Cf. Reynolds, *loc. cit.*, p. 461.

\(^{52}\) Wilcox, Clair, *Competition and Monopoly in American Industry*, TNEC Monograph No. 29, p. 121. DuPont acquired controlling interest in United States Rubber in 1929 according to *Rubber Age*. 

Editorials in the Rubber Age during 1930 were particularly harsh with respect to price cutting and its disastrous effects. Automobile Producers generally acting on rubber firms' reluctance to engage in concerted action, obtained very favorable treatment. Rubber Age, Vol. 26, No. 5, p. 539, February 25, 1930, quotes a Standard Statistic's report as saying that rubber companies were "selling below cost" to original equipment purchasers.

For the late 1920's several questions are pertinent. First, to what extent did firms take cognizance of decreasing replacement opportunities? What new products were available to take up the slack? What were their predictions about future demand?

Second, what was the role of price competition in relation to plant expansion?

Third, what factors particularly influenced the over-expansion (if it was such) in the late 1920's? What factors specifically brought expansion to a stand-still? What were the processes of over and under estimation.

See Chapter VI for some statistical material on the increase in manufacturers' inventories of casings.
Hi. The 1930's, World War II, Post-War

The Depression beginning in 1929 of course made further plant expansion impracticable for several years. Apparently, however, the pressure for modernization and the introduction of new technology is such that capital expenditures could not be completely ignored during the 1930's. In Chapter VI we will investigate the extent to which introduction of new machinery was undertaken in the 1930's.

Further, between 1934 and 1938 a considerable amount of plant expansion went on in terms of decentralization (building plants in other sections of the country) and extension of foreign plants in response to import duties on tires to certain countries. Goodyear built a plant in Gadsen, Alabama, for example, partly in response to pressure from Sears, partly in response to labor problems in Akron. The motivation for plant expansion or modernization in the 1930's will be worth investigation.

55. The Gadsden development began, however, in 1929.
No adequate account exists, to the writer's knowledge, of the relation between awareness of war possibilities and investment in new plant. Several firms began to be acutely aware of the desirability of synthetic rubber in the light of Far Eastern power struggles and much research went into development of synthetic processes. But it will require investigation of more detailed sources to indicate how such considerations resulted in investment decisions prior to Pearl Harbor.

The Encyclopedia Britannica notes that rubber firms were unwilling to risk capital in synthetic capacity to the extent government sources predicted a need.

A report published in 1950 by the Executive Office on Synthetic Rubber has this to say about synthetic rubber capacity prior to World War II:

"Some progress in the synthetic rubber field had been made prior to the United States' entry into World War II. Neoprene had been marketed commercially since 1932 (by DuPont) . . . construction was started in 1940 on a facility which would have an annual capacity of 10,000 tons compared with production in 1939 of 2,000 tons . . . in addition butyl had been discovered in 1937, and construction of a plant to produce it . . . at Baton Rouge, Louisiana.

These efforts were, however, far too small to provide quantities of rubber needed for a war effort. For this reason in May 1941 the Rubber Reserve Company was assigned the responsibility of developing a synthetic rubber industry . . . The program was expanded in early 1942 to 805,000 long tons." from Synthetic Rubber, Recommendations of the President, January, 1950, for Maintenance of the Synthetic Rubber Industry in the United States and Disposal of Government Owned Synthetic Rubber Facilities, prepared by John R. Steelman, p 23.

Note the difference between 10,000 tons capacity in 1939 and the goal of 807,000,000 tons in 1942. Synthetic and natural prices simply were not competitive prior to W W II.
A purely financial interpretation of the history of rubber firms from 1912 to 1930 is given by Beights. He emphasizes "over-expansion" of capital equipment during the 1920's and "over-expansion" of short-term credit prior to the 1920's. Beights argues that rubber companies did not observe the "law of proportionality" of corporation finance which asserts that there exist certain proper relations among the assets, liabilities, stocks and income of individual firms. Inventories and current liabilities increased too fast, Beights says, compared with total assets and sales prior to 1920. Current ratios went from 1 to 1, down to 2 to 1, prior to 1920. "The failure of the Goodyear Company was due


59 Actually, information on investment in the rubber industry is very difficult to obtain. Cf. The Development of American Industries, edited by Glover; John G., Cornell, William B.; and Madden, John T., New York: Prentice-Hall, 1946, p. 266 in "The Rubber Industry," written by A. L. Viles, then President of the Rubber Manufacturers Association, pp 249-268. Viles notes a tendency to reduce funded debt by issue of no-par value stock during the late 1920's and to finance expansion from stock sales also. Since the depression, however, he notes a tendency to reduce bonded debt out of earnings rather than flotation. (In Chapter Seven one official is recorded as of the opinion that stock issues for plant expansion are out of the question at the present time.) Beights used published corporate financial statements for his data.
primarily to an over-expansion of fixed assets financed through short-term borrowing." For the 1920's, Beights emphasized the importance of increasing productivity which accompanied by large scale capital investment, made for "over-expansion, price wars, and low stock earnings."

Much of his analysis is a correct statement of the history and problems of the rubber industry prior to 1930. His conclusion is not correct, however, that they suffered from "incompetent" management since they engaged, according to his analysis, in too much borrowing prior to 1920 and too much plant expansion after that time. Beights neglects the role of expectations when he asks that proportionality among assets and liabilities (all items in the financial statements, in fact) be invariant through time.

The record of the war years was one of service and a

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60 Beights, op. cit., p 133. Beights asserts that prior to 1920 working capital decreased from 68.41% of total assets to 35.95% while fixed assets went from 31.59% to 64.05% for all major rubber firms. Current liabilities rose from 19.36% to 26.77%. The current ratios were halved generally. Preferred stock was issued rather than common (preferred 32.58% up to 43.20%, common $8.06% down to 30.03%). The preferred proportionality found by Beights was Cash - 10% of total assets, Receivables - 15% of total assets, Inventories - 25% and Plant and Equipment - 50%. These figures (as well as the decimals above) are probably, to say the least, spurious.


62 In face, the evidence is more impressive that these individuals were classic examples of successful entrepreneurship.
high rate of production, and the development of new synthetic capacity. Investment decisions during the war years will not be examined in much detail.

The legacy of World War II was synthetic production, controlled rubber prices for a time, increased capacity from war-time expansion, new products (Airfoam, Pliofilm, Neolite), and a large back-order demand for cars and rubber products. The industry had become more than ever a chemical industry with the introduction of new kinds of non-tire products and this contributed to diversification. The Akron Chamber of Commerce pointed out in 1951 that the rubber producers "emerged from World War II with a new knowledge of the chemistry of plastics, a greatly expanded research program, (and) new products" and that the Korean war imparted "impetus to still another phase of the diversification . . . ordinance items and military aircraft."64

There is evidence that firms in the post-war period were spending considerable sums in modernizing and expanding factories, and developing new products. However, the firms generally came out of the war years with greatly increased facilities for filling the initial back-log

63 The President of Goodrich estimated capacity pre-World War II to be 65,000,000 tires annually and post-World War II capacity to be 110,000,000 tires annually. Rubber Age, Vol 57, No. 6, September, 1945, p 713.

of orders. The problem of utilization of plant was still potentially present, however, and some firms turned to entirely new ventures, Goodyear even engaging for a time in prefabricated housing.65

This is indicative of one of the fundamental methods which rubber firms (and others, even for example in petroleum) have used to meet uncertainty and a large capacity tending toward a surplus plant. Diversification has come about not merely as an uncertainty reaction but in response to opportunities consistent with the firms' technical abilities. However, it serves as a

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65 There was considerable question as to what disposal should have been made of the new synthetic capacity largely financed through governmental sources, in one way or another, and in many cases owned by the federal government.

The report Synthetic Rubber has an excellent summary of the problems of plant disposal pointing out that the major problem was to insure that the capacity came under private ownership but that growth and development continue to take place. Steelman clearly recognized, although not explicitly, the potential excess capacity in the industry.

An editorial in Rubber Age in 1946 said concerning threatened price wars that "the fault . . . lies . . . in the greatly expanded tire production facilities which came into being during the war. If future price wars are to be avoided one of two things must happen: Markets must be expanded or production facilities must be curbed. In the same year a report by Standard and Poor stated that while for the long run "overcapacity (was) intensified by wartime addition to facilities" greater stability was forecast due to increasing diversification.
strategy for meeting an uncertain future.
the discontinuities associated with the entrepreneur's inability
to maintain capital stock in the desired relationship with
output. The discontinuities associated with the finite
production capacity of the investment goods industries and
the longevity of durable goods have been diagrammed by
Goodwin as a "square wave" of national income and a "saw tooth"
capital stock curve as follows:

Goodwin extends his analysis to include a steady secular
growth in the desired amount of capital due to technical
progress, a "dynamical multiplier" as outlined by Hicks, and
an investment lag brought about by the time necessary for

22 Goodwin, R. M., "The Nonlinear Accelerator and the Persistence
of Business Cycles," Econometrica, Vol 19, No. 1, January,
1951, pp 1-17. The terms "square wave" and "saw tooth"
curve were not used by Goodwin in his diagram on page 5
of the article, but were borrowed from elementary electronics.
Chapter V

A FACTOR ANALYSIS

In this chapter a factor analysis will be performed on certain data relevant to the largest of the rubber manufacturing firms, the Goodyear Tire and Rubber Company. The object of the analysis is to discover, in the firm's history, a few basic components (factors) representative of the variables studied. The factors extracted will be, in the nature of the statistical process, distinct and independent of each other.¹

Data from Goodyear's financial statements (as published in Moody's) and other sources, were compiled for the period 1915-1950. These data include items for which consistent series can be made on the basis of balance sheet or income statement figures, an index of cost of new plant for the whole economy, an estimate of national disposable income and the amount of the federal deficit for each year.

The selection of the twelve variables delimits, of course, the final result. These variables were selected because they were impressionistically viewed as important in the light of recent macro-economic theory. For example, data on the federal deficit,

¹ Cf. Thurstone, L. L., Multiple-Factor Analysis, Chicago University of Chicago Press, 1947. Roughly, factor analysis is the inverse of analysis of variance. It resembles multiple correlation coefficients are independent variable loadings which minimize the variance in the dependent variable not explained by the independent ones. Factor analysis does not assume, however, any "independent" or "dependent" variables. Rather it is an attempt to detect some meaningful order among the variables.
and total disposable income, seemed relevant on the basis of this theory, as did an index of cost of new plant. However, the inadequate nature of conceptual ties between the theory of the firm and theory of the total economy are well known. Empirical research must therefore take account of this deficiency and include some compensatory improvisation. The purpose of this minor analysis is to suggest some tentative operational definitions in this realm.2

Data on some variables, for example interest costs, could not be compiled for the entire time period and were omitted. A more satisfactory procedure would have been to consider the data during several short time periods, performing a factor analysis for each period. This procedure would have permitted the inclusion of more variables, and would have avoided some of the static bias which the present study exhibits.

Goodyear was selected for study because it is the largest firm in the industry. It has experienced a great deal of expansion of plant and equipment and has many times faced the question of investment decisions in an uncertain future. The company has experienced at least one difficult financial situation (1921). And a considerable amount of information is available concerning this and other aspects of the firm's history.

2. As Modigliani has pointed out, ex-post data are not completely satisfactory for analysis of expectations, since it is usually not possible to determine to what extent the executives predicted the data ex-ante and acted accordingly.
The twelve variables selected were: Sales, Inventories, Capital Expansion (estimated from Fixed Asset Account), Cash, Marketable Securities, Notes and Accounts Receivable, Dividends, Turnover, Current Ratio, Disposable Income, Federal Deficit, and an Index of Cost of New Plant. A full definition of each variable, sources of data, entries for each year, and the computation of intercorrelations between the variables will be found in the Appendix to this chapter.

The procedure followed was first to compute the intercorrelations among the twelve variables. A factor analysis was then performed on the intercorrelations. In a set of correlations with some internal consistency, a few orthogonal (i.e., perpendicular) reference vectors may be found which explain most of the variance in the original data. Loadings on the factors are equal to the square root of the variance attributable to the factor.

3. Table 5.1
These factors are more easily visualized for explanatory purposes than are the more numerous correlation coefficients.\footnote{Gerhard Tintner recently commented on the effectiveness of factor analysis as an explanation of variance. Cf. \textit{Econometrics}, John Wiley & Sons, 1952, pp. 102–114. Tintner notes "A possible use of factor analysis in economic statistics is the following: We have frequently series of data which are very short, e.g., about 20 yearly observations. By replacing several variables with a few principal components we may be able to save a considerable number of degrees of freedom which would otherwise not be available. This may conceivably be of some importance in practical applications of correlation methods to economic data. There is evidently a relation with the aggregation problem . . . the most important class of problems to which the method . . . could be applied are perhaps those connected with statistical questions arising from the transition from micro-economic to macroeconomic analysis. (Emphasis supplied) These questions have been discussed from the point of view of economic theory (Cf. O. Lange, \textit{Price Flexibility and Employment}) but never verified statistically by the use of valid methods."} These factors represent a set of Cartesian reference axes for the vectors associated with each variable. The correlation between any two variables is equal to the scalar product of their vectors, where a variable's vector (sometimes referred to as a test vector) is the projection of a variable on the reference axis. Since an indefinite number of orthogonal reference vectors may be drawn through any set of test vectors, care must be taken that the results seem realistic and meaningful.
Table 5-1

Intercorrelations and First Residuals of Twelve Variables Relative to the Goodyear Tire and Rubber Company, 1915-1950

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Source: Appendix, Chapter V

Note: The right upper portion represents intercorrelations. The lower left portion represents residuals after extraction of three factors.
The loadings obtained (after rotation of the reference axes) on the three factors are given in Table 2. In three dimensions, these loadings appear as test (variable) vectors with projections on Factors I, II, and III. Normalized so that each vector extends to the surface of a unit sphere, they appear as in Figure 5.1, p. 7.

Table 5.2

<table>
<thead>
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<th>Variable</th>
<th>Factor Loadings</th>
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<td></td>
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</tr>
<tr>
<td>1 Plant Expansion</td>
<td>70</td>
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<tr>
<td>2 Sales</td>
<td>88</td>
</tr>
<tr>
<td>3 Inventories</td>
<td>98</td>
</tr>
<tr>
<td>4 Cash</td>
<td>75</td>
</tr>
<tr>
<td>5 Marketable Securities</td>
<td>54</td>
</tr>
<tr>
<td>6 Accts and Notes Rec</td>
<td>90</td>
</tr>
<tr>
<td>7 U. S. Disposable Income</td>
<td>94</td>
</tr>
<tr>
<td>8 Index Cost of New Plant</td>
<td>96</td>
</tr>
<tr>
<td>9 Federal Deficit</td>
<td>21</td>
</tr>
<tr>
<td>10 Dividends</td>
<td>-21</td>
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<tr>
<td>11 Turnover</td>
<td>36</td>
</tr>
<tr>
<td>12 Current Ratio</td>
<td>-39</td>
</tr>
</tbody>
</table>
Figure 5.1

Normalized Test Vectors of Variables Relating to the Goodyear Tire & Rubber Company, 1915-50

Source: Table 5.21, Appendix.
The usefulness of such a factor analysis depends, as was pointed out earlier, upon a plausible and realistic interpretation of the factor loadings. Technically this involves the problem of "rotation" of reference vectors. From an experimental point of view it involves an indirect confirmation or rejection of inferences drawn from more remote hypotheses.⁵ The following interpretation is advanced.

Factor I has high loadings on Capital Investment, Sales, Inventories, Cash, Marketable Securities, National Income, and Cost of New Plant. This factor, following, Hicks, will be termed one representing induced action.⁶ It reflects responses of the firm to changes in national output. Figure 5.1 indicates a cluster of tests near the top of the sphere and two tests (dividends and current ratio) with negative projections on Factor I. This is a geometric representation of a situation evoking induced investment in an individual firm.

Contrary to some findings which emphasize the association of profits and expansion,⁷ the thesis here is that increasing sales associated with changing national output force plant expansion because


⁶ Hicks, The Trade Cycle, p 37.

⁷ Cf. J. Tinbergen, C. F. Roos, G. H. Fisher. Profits, of course, are expected but they are not the "signal." Publick utility planning, and planning for non-manufacturing concerns generally, may be quite different.
of a firm's inability to supply current demand. Thus short-run successes have long-run consequences since expansion, once completed, becomes the inherited equipment with which the firm faces succeeding production and sales situations. It is interesting to note that Variable 12, Current Ratio, has a negative loading along this factor. This is an indication of a firm's desire to capitalize on opportunities for current orders at the expense of sounder financial ratios. Even Turnover, Variable 11, has a relatively small loading along this factor (especially as compared with the loading of this variable on Factor II) indicating a desire, possibly, to have materials and finished products on hand, and a low turnover rate, rather than miss sales. Cost of New Plant has one of the highest loadings on this factor, indicative according to the thesis here, of its passive role in the firm's decisions.

The selective perception which makes for changes in the importance attributed to financial ratios has been interpreted by some as poor financial management. However, it is merely an example of the general tendency of decision makers within firms to tailor their opinions to fit what they think is the prevailing climate of opinion. It is typical of the INDUCED action which led one author of a TNEC monograph to assert that plant expansion in the American economy has not been occasioned by profit histories but the
relationship between sales and capacity, and technological requirements.

The theoretical conclusions reached by Hart, Marschak, Tintner and others are illustrated by the loadings on this factor. The desire for flexibility will lead firms to engage in capital expansion mainly when the opportunity for recovery of outlay seems certain, and when available financial funds are adequate. Cash has a loading of .75 and sales .88, indicative of the degree to which these requirements are satisfied. With consistently high loadings on these variables, it is likely that the influence of Factor I on the dispersion of estimates through time is in the direction of smaller deviations. In Shackle's analysis, this would be reflected in a changed potential surprise curve, the curve generally shifting toward less potential surprise associated with each gain and more potential surprise associated with each loss.

Joel Dean, Terborgh and others have commented on the importance attaching to the availability of funds and short payoffs. These conditions are satisfied by the loadings on Factor I. Likewise, these loadings do not contradict the conclusions drawn by contemporary social psychologists, as outlined in Chapter III.

8. Taitel, Martin, Profits, Productive Activities, and New Investment, TNEC Monograph No. 12, 1941, p. 131.
fabrication of new orders. This leads to a cycle theory not greatly different from that outlined by Hicks except for the more rigorous definition of discontinuity at the turning points, which is Goodwin's contribution.

C. Expectations and the Trade Cycle

The principle work which turned the attention of economists to expectations is Lord Keynes General Theory of Employment, Interest, and Money. Although other economists, for example A. C. Pigou, often noted the importance of "business confidence," none was able to popularize the idea among economists as did Keynes. The importance Keynes attributes to expectations is well summarized in the Preface to the General Theory, where he says "A monetary economy, we shall find is essentially one in which changing views about the future are capable of influencing the quantity of employment and not merely its direction." While there are many oversimplifications in the General Theory (for example, an undue emphasis on the rate of interest), it is a bench mark in the history of economists' interest in expectations.

Despite its importance in this respect, the General Theory

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An important hypothesis which can be derived from this factor is that plant expansion rests, in major degree, on a firm’s efforts to supply current orders greater than its existing capacity. This hypothesis is amenable to operational definitions, and will be further examined in the next two chapters where trade journal accounts of plant expansion will be examined in Chapter VI, and the attitudes of rubber executives will be studied in Chapter VII.

Following Hicks, Factor II will be termed one depicting Autonomous actions. Autonomous investment, according to Hicks, refers to "public investment, investment which occurs in direct response to inventions, and much of the 'long-range' investment . . . which is only expected to pay for itself over a long period." Autonomous action, for our purposes, will then be response to changing technology and secular demand.

This factor has a loading of .41 on Plant Expansion (Variable 1), as compared with a loading of .70 on Factor I. Thus the AUTONOMOUS factor is important in plant expansion, but not as important as INDUCED action. Sales likewise have a significant loading but not nearly so high as for Factor I. Inventories and Cash have no significant loading while Turnover has a loading of .90. This is not inconsistent with the interpretation of Eiteman and others

who assert that businesses operate with a view to maintaining some kind of "normal" inventory, turnover, and cash balance. Current ratio has a loading which differs markedly from that on Factor I. While Factor I has a loading of -39 for Current Ratio, Factor II is loaded plus .53. For autonomous action, the financial ratios play a more important positive role. Disposable Income has a loading of only .27 which is an amount not inconsistent with the view that Factor II refers to secular demand and technological change. Likewise the negative loading of -.20 on marketable securities is not surprising, since marketable securities accounts are governed by short-run considerations.

Dividends have a positive loading of .54 on this factor representing a general policy of attempting to maintain dividend payments, while on Factor I the loading is -21 indicating less concern with dividends in the attitudes generated by Factor I.

Factor III might be a factor of RETRENCHMENT. In general, it seems less meaningful than the other two, and this is in fact borne out when one notes in the factor analysis proper that Factor III is the centroid through variables 7 and 8 only. This factor shows dividends at .60 which coincides with the apparent policy of Goodyear (which can be verified in other sources) of paying dividends even

when the firm makes a net loss for a given fiscal year. Turnover is at -.55, sales at -.15, indicating an extremely slow movement of product. The current ratio has a positive loading of .30 which is significant as compared with other loadings along this factor. Marketable securities, a safer place for cash than fixed investments, has a loading of .20.

The Federal Deficit has a loading of -.43 on this factor. The loadings of this variable are difficult to interpret, but along this factor there is a slight indication that government retrenchment has in the past accompanied private retrenchment. This is, of course, only partially correct. The loadings of Federal Deficit on the three factors do not seem generally to be very meaningful.

Obviously, an analysis of this type has many defects. One problem is that factor loadings are clearly a function of the time period studied. It seems plausible that the analysis would be more meaningful had several factor analyses covering shorter time periods been made. Further, an indefinite number of factorial structures would be equally representative of the correlation matrix shown in Table 1. All that can be maintained is that the one shown yields a reasonably small number of factors with small residuals in the final residual table, and that these factors can be given a meaningful interpretation. There are no tests, of the nature say of a t-test, for indicating the degree of confidence attaching to the factor loadings.
The raw data, like that generally obtained in economic research, is a compromise between theory and history. Some of the eccentricities of these data are discussed in the appendix where each time series is listed.

However, in the absence of more operationally meaningful hypotheses from classical or Keynesian theory, the Goodyear factor analysis provides a theory of investment complementary to that advanced in previous chapters. It presents a picture of entrepreneurial action having three facets. The first refers to responses generated by changes in National Income where capacity becomes inadequate to fill current orders. This is consistent with theoretical models of uncertainty reactions, as well as empirical psychological findings.

The second facet, autonomous action, includes factor loadings of a more cautious nature and in the main summarizes responses of a longer-run nature. The third factor has loadings representative of attempts to "cover" or retrench in difficult financial situations.

These conclusions are admittedly one set out of several possibilities. They are made more plausible by the general

11. The reader might try to devise operational definitions of situations where the marginal efficiency of capital is less than the rate of interest or where interest on internal funds loaned to others is greater than the expected return from a firm's own project.
conclusions in social psychology to the effect that decisions depend upon simple, concrete, meaningful and current phenomena. The tendency to be increasingly more cautious than is actuarially justified, is supported by limited psychological evidence, outlined in Chapter II.

The significance of these conclusions, if they are valid, may be expressed as follows. First, investment factors are stated in more operationally significant terms. The most important investment consideration is said to be the relation of capacity to current demands. This may be readily studied by personal interview as well as in narrative sources. Other important considerations relate to the technological necessity of re-equipment action and to plans for meeting secular demand. These are more ambiguous but they are at least few in number. Together with the apparent desire, and necessity for, financial flexibility they constitute a brief summary of investment action.

Second, these factors, given a somewhat simplified graphic interpretation, demonstrate potential instability in the economic system in a striking way. This is not a surprising conclusion, but as shown in Figure 4 below, the summation of the instabilities in each firm throughout the economy, seems significant.
The sharp peaks denote expansion for the fulfillment of specific, short-run orders in excess of existing capacity, a situation connotated by Factor I. Since these peaks will occur for all firms at approximately the same time (this is the nature of induced investment) the instability becomes rather pronounced.  

Third, as has been previously stated, the situations produced by these investment factors mean that capital accumulation will proceed unevenly in the aggregate and among individual segments of the economy. Long-run capital accumulation will occur on the basis of short-run sales.  

Fourth, while the evidence is not as convincing as it might be, there is some indication that firms do require a new understanding of situations before they can change their actions. For example, dividend payments are often made more as a result of inertia than reason, according to these loadings. The saturation-time for this understanding of new situations is not clear from the loadings, however.

12. These peaks of capital expansion are similar to the voltage pulses generated by two vacuum tubes coupled with a very small capacitance. The economic analogue required for a less unstable system is, then, a capacitance which will absorb the stimulating effect of a change in national output and spread it over a longer time period. Cf. Reintjes, J. F., Editor, Principles of Radar, MIT Press, McGraw Hill Book Company, New York, pp 2:27-2:28. Diversification of production seems to be the answer provided by many firms.

13. Whether these conclusions seem "liberal" or "conservative" will depend upon the value one places on such attributes of an economic system as "stability" or "flexibility".
Factor analysis is not capable of describing adequately the time-distribution of investment responses. Cycle theory has long contained the notion that firms tend to lag in their investment action prior to the peak of the cycle. Toward the peak, along the time dimension, there is then a flurry of investment activity. This is certainly the prediction to which the analyses of Hart and Shackle lead. If one examines the plant expansion record of Goodyear this is seen to be true, especially during 1928–9 and 1920.14

The theory of investment outlined here should be modified to suggest that while the main stimulus for such action is the increasing ratio of sales to capacity, the expenditures are probably (and roughly) an exponential function of time. Thus, after Hart and Shackle have demonstrated the asymmetrical results of "good" or "bad" news, and after the factor analysis here, a critical question remains – when do entrepreneurs find their inadequate plant unsatisfactory?

Chapter VI

NARRATIVE SOURCES

A. Introduction

Empirical evidence for the theory of investment behavior advanced in this study may be found in various narrative sources. One source of information is the trade journal, to which some attention will now be given.¹

If the theory thus far advanced is valid, trade journal articles, in their reports on plans for plant expansion, should refer consistently to short-run, tangible, and common-place considerations. Casual conversation with business people suggests, for example, that a backlog of orders and prospective orders in the present quarter are important, tangible, and (to the executive) familiar influences in formation of expectations about the future. A plant "bursting at the seams" with production is extremely important as will be shown in this and the next chapter.²

¹. The Harvard Business History Group lists the trade journal as an important and valid research source. Cf. Larson, Henrietta M., Guide to Business History, Harvard University Press, 1948. Larson notes that "Trade journals are one of the most important sources of information in research in business history . . . they are not a substitute for original business records but useful as a supplement to them . . . (and) almost anything that concerns an industry . . . may be found in trade journals." p 994 No. 12 in Harvard Studies in Business History.

². Backlogs of orders are essentially "negative inventories."
"Induced investment" occurs in a situation of this nature. And in fact, the basic factor in investment decisions is the relationship between current sales and capacity. Product diversification, decentralization, foreign expansion to avoid high tariffs, a complex organizational structure and other considerations operate to obscure this fact. However, numerous articles in the India Rubber World and Rubber Age, two leading trade journals in the rubber products industry, substantiate it.

B. Post World War I Depression and Recovery

Following the Post World War I depression, 1920-21, trade journals contained many references to these short-term influences which have long-run effects. For example, there were numerous accounts of the importance of current sales.

The Columbus Tire and Rubber Company showed sales in 1922 205% above 1921 and "during the first two months of 1923 sales show an increase of 100% over the same months in 1922... The company is installing a large amount of machinery and equipment and will materially increase its production in the near future.3

Further, "The Firestone-Apsley Rubber Co. of Hudson, Massachusetts, is making changes in the factory layout by which the plant capacity will be increased by nearly one-third. These changes have been ordered in anticipation of an increased demand for the company's products in the near future (italics mine)\(^\text{4}\)

Republic Rubber Corporation of Youngstown, Ohio, has improved its industrial and financial condition to such an extent that the time is not too far distant when the present receivership may be discharged by the court . . . The plant has been enlarged and new mechanical equipment installed to take care of increased volume of orders. (italics mine)\(^\text{5}\)

"Several members of the rubber novelties trade in Akron have reported an increasing volume of business. Since the novelty . . . line . . . can be classified more as luxuries than tires . . . an increase such as has been reported is regarded by many . . . as an indication of good business in the general industry.\(^\text{6}\)

The President of the United States Rubber Company reported in his remarks to stockholders April 17, 1923 that "the situation clearly reflects the improvement in general business conditions, particularly the number of orders calling for rush delivery." The severe winter, he noted, had significantly reduced dealers' stock to a minimum.\(^\text{7}\)

In September 1922 the president of the B.F. Goodrich Company was described as "bullish" in an article in Rubber Age. Part of his statement indicated that at this moment our sales are running higher than ever before . . . and the future never looked brighter.\(^\text{8}\)

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5. Ibid., Vol. 11, No. 8, July 25, 1922, p 285.
6. Ibid., Vol., 11, No. 7, July 10, 1922, P. 212.
7. Ibid., Vol., 12, No. 2, April 25, 1923, P. 50.
8. Ibid., Vol., 11, No. 11, September 10, 1922, p. 398
did not "release expectations from their status as a datum." G. L. S. Shackle, in a less well known work of the 1930's, argued that expectations needed to be given content. An unexpected increase in income, according to Shackle, is a different datum for businessmen than an expected increase.

An American economist and monetary theorist, James Angell, was also emphasizing about this time anticipations and expectations in relation to investment activity. He said, in part:

"In modern societies, the component of total spending which fluctuates most widely in relative terms, which commonly varies first in time, and which in general seems to act as a trigger mechanism, is spending for investment purposes."25

Angell advanced the view that cycles are endogenous in impulse and therefore set about to explain their structural form, or their propagation. It was his judgment that "changes which take place in the volume of new investment within . . . a 'short' period are due to changes in . . . anticipations - that is, the opinion which business men and other potential investors hold about the probable course of business and general economic activity in the nearby and not too distant future."26


26 Ibid., p 6.
The Dunlop Rubber Company of England had at Buffalo, New York, a plant which had been standing idle "for the past year" (September 25, 1921 - September 25, 1922) because the company felt that it had "saved money by allowing the American factory to remain idle, because of declining tire prices and poor business conditions in general on this side of the Atlantic". This is, of course, merely the classic case of variable costs greater than selling price, although it might be categorized as a user cost situation. That is, it would be more profitable to use the plant later rather than exhaust it during a time of poor business conditions. This is an example of reactions tending to contract plant activity, and plant expansion.

Only a short time elapsed, however, until the Dunlop plant commenced operations again. In the fall of 1922, Rubber Age reported the plant as employing 10,000 men, this staff to increase as "sales justify."

Some further instances of the importance of current sales are as follows:

The Goodyear Rubber Glove Company, Naugatuck, Conn., erected a new $50,000 factory building to "provide for the increased business of the company."  

In the fiscal year ended August 31, 1922, the General Tire and Rubber Company increased its surplus account from $200,000 to $892,126. The general manager O'Neil said "This will be our greatest year. We are now planning to double the capacity of our plant."  

Meade Rubber Company was building in April, 1923, another two-story brick plant due to "the increase in volume of business."  

In May 1923, new "machinery was being installed by the Wildman Tire and Rubber Company, Port Clinton, Ohio, as a result of current demands, for the company's products."  

Further, the Miller Rubber Company reporting sales in 1922 130% above 1921 sales planned improvements and new equipment so that the company might "be able to maintain its position in the industry."  

11. Ibid., Vol. 12, No. 2, October 25, 1922, p. 54.  
It is true that portions of increased earnings are often applied to the reduction of indebtedness, thus increasing a firm's flexibility. For example, one firm in Massachusetts began in 1922 to reduce bank loans rather than expand, even though their sales were rather favorable. Firms, however, to a considerable extent, use these funds for internally financing expansion. The General Tire and Rubber Company, planning for the expansion noted above, (three three-story buildings and large amounts of equipment) anticipated no new outside indebtedness. Reduction of indebtedness more often occurs in a slump. In 1949, for example, several companies made progress in reducing their indebtedness. However, it seems doubtful that there is any "lead" time in these actions significant for predicting such a recession.

15. Rubber Age. Vol. 66, No. 6, March 1950, p. 691. The United States Rubber Company report for 1949 said that "great progress had been made during the year in improving the company's financial position. Cash and U. S. Treasury Savings Notes totaled $57,498,896 at December 31, 1949 . . . $9,583,066 higher than at the previous year end and the Goodyear report for 1949 stated that the company's "working capital reached a new high. The ratio of current assets to current liabilities was 7 to 1 compared with 6½ to 1 at the previous year's end.

16. A considerable research task would be necessary to establish increasing financial cautiousness as "leading" recession. In the light of this study, a more likely interpretation is that adjustments to meet the recession brought about a more favorable set of financial data.
A situation basic to investment action is that in which a firm considers itself compelled to expand in order to avoid higher labor and other costs from increased shifts and intensive plant use. This situation is somewhat similar to what Katona terms a forced action situation and has elements of a decision involving non-habitual action.

Suppose a firm's orders increase. The firm reacts to increasing orders in a manner calculated to reduce fixed commitments to a minimum, and in a manner which does not require a new understanding of the situation. The firm can usually initiate overtime, or employ an extra shift of workers. There is much evidence that such action is easily accomplished, since most plants operate

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17. Cf. P. W. S. Andrews, Manufacturing Business, London: MacMillan & Company, 1949, pp. 93-5 where he notes factors making for reserve capacity. Mr. Andrews notes that the cost curve is horizontal over a considerable output range (as has been noted by others) and that sales will ordinarily have to expand a great deal to initiate much plant expansion. The acceleration effect appears, therefore to affect induced investment asymmetrically—achieving a much smaller amplification of income in the upward than in the downward direction, and with a longer time lag in the upward direction. This is consistent with a $\Phi$. Cf. Fisher, Gene H., "A Simple Econometric Model for the United States, 1947-1950," Review of Economic and Statistics, Vol. 34, No. 1, February 1952, pp. 46-49.

18. Theoretically this is the most important motivation for plant expansion in that it takes account of the principles of 1) Flexibility (Hart and Marschak) 2) Safety First and Increasing Risk (Roy and Heady) 3) Minimaxization (Modigliani, McDonald) 4) Asymmetry of surprises (Shackle) and 5) Redundancy (Communication Theory). It allows for a time lag prior to understanding a new situation (Katona) and is consistent with the entrepreneurial lags discovered by Terborgh.
considerably below "capacity." If orders continue to increase, a third shift may be added; and if the third shift is inadequate to handle current orders (or if unit costs rise because of non-proportional output and/or higher wages) plant expansion will be considered. In classical terms, this means that the scale of output turns more on the compulsive force of sales opportunities and rush orders than on diseconomies or economies of size.

Thus, current sales, perhaps especially rush orders, are important and the relationship of orders to plant capacity a critical one. If orders for delivery in the near future accumulate and the back-log continues, decisions concerning plant expansion may be thrust upon a firm. Trade journals contain many such accounts, some of them listed below. These items are, in some respects, indication of the fact that prosperous conditions merely bring many plants to "capacity".


21. When this sentence was first drafted, the writer was not familiar with TNEC monograph No. 12 emphasizing this consideration. Thus the conclusion here and that by Martin Taitel in the 1930's were arrived at independently and by reference to different theoretical and empirical considerations. Taitel, Martin, Profits, Productive Activity and New Investment, TNEC Monograph No. 12, 1941, p. 131.
On May 25, 1923, Rubber Age reported that the Ajax Rubber Company had sales 100% above those of 1922. However, plants were only operating close to capacity.22

In March of 1923, the magazine had reported that "activity in the production of tires in the Akron district is at the highest point in several years . . . all factories are working at capacity and many have enlarged their facilities. Labor was reported scarce and bonuses were being offered for efficiency and lack of absenteeism.23

And on March 10, 1923 another "slant . . . which gives promise of highly satisfactory business this year is that secured by a canvass of the mold and core, equipment and machinery makers. All these plants are doing a capacity business and several of them are working into the night.24

Further confirmation of the point is found in an article concerning Studebaker-Wulff in April, 1922. They planned to increase production but even after the contemplated increase,

23. Ibid., Vol. 12, No. 11, March 10, 1923, p. 412.
24. Ibid., Vol. 12, No. 11, March 10, 1923, p. 412.
there would be "sufficient orders on hand to keep the plant running for the next two months."^25

And one of the partners in Denman Meyers reported that "the factory was in a position to take care of all increased business until forced by necessity (italics supplied) to build further additions to the plant."

Plants forced to close temporarily react to the signal which one would expect in renewing production, namely, an accumulation of orders. On May 12, 1922, Rubber Age reported that the L. Canlee Rubber Company plant (owned by United States Rubber Company) closed for a month but would resume production "as soon as the accumulation of orders warrants."

Rubber Age reported in June, 1922 that "Akron Production (Was) Nearing Capacity". "Dealers are now placing their orders with confidence that their stocks will be rapidly depleted by replacements. Almost all tire factories in the city are straining every effort to

25. Studebaker-Wulff experienced a successful and finally expansive year. By July, 1922 they were employing a night shift because of the "prompt sale of all tires manufactured each day . . . the company unable to form a surplus stock." And by December, they had decided to double the output of their factory and install new machinery to cost between $35,000 and $50,000; plant operating on day and night shifts. By 1926 they were, however, in receivership. Cf. Rubber Age, Vol. 23, No. 1, April 10, 1928, p. 34.
fill as quickly as possible the long-delayed orders which continue to come in. Influenced by an undeniable shortage of skilled tire makers and dissatisfaction of employees occassioned by efforts to increase production, several companies have declared a wage increase.  

This demonstrates that companies first endeavor to increase production with existing plant and equipment by increasing employee output or hours. If this fails or becomes too costly, plant expansion will be considered.

In the third quarter, for example, of 1922 an article noted that one firm was "working day and nite" employing three eight-hour shifts. Production capacity had been enlarged from 200 to 400%, by the addition of $250,000 worth of new buildings and machinery. For the first five months of 1922, a gain of 67% in tire sales was experienced compared with 1921. This depicts the close association of increasing sales, extra shifts, and plant expansion.

Further indication is provided in the case of the Eclat Rubber Company, Cuyohoga Falls, Ohio, operating in October 1922 with three eight-hour shifts, while floor space was doubled and new machinery added recently.

26 Rubber Age, Vol. 11, No. 6, June 25, 1922, p 25.
27 Ibid., Vol. 12, No. 1, October 10, 1922, p. 20.
As an indication of the reserve capacity prevalent in many firms the rubber machinery plants in Akron reportedly were "encouraged with present business conditions" in the autumn of 1922, firms reporting business 60% above normal or 75% of capacity." These figures are rough estimates but they are representative of the situation. By the next March, mold and core, equipment and machinery makers were doing a capacity business and several were working into the night to keep up with orders.

A speech by Mr. W. O. Rutherford, vice-president of the B. F. Goodrich Company during this period characterizes the tendency to extrapolate short-term data to long-term predictions. Mr. Rutherford (being, according to the trade journal, "bullish" about the future) said, in part:

I have never seen a brighter outlook nor more hopeful conditions ... I think you can take the Goodrich Company as a very fair index of what is going on in a majority of industries. We for instance, have been so busy supplying an ever-increasing market that we find the 24-hour day all too short. We are obliged to have three sets of employees working in three shifts of eight hours each.

How fast the rubber industry is taking its place as one of America's business leaders may be judged from the fact that in last month our sales increased 150 per cent over the month of April, and our May and June business, compared with May and June of last year, nearly doubled. Sales of cord tires since January of this year have been double those of the first five months. At this moment our sales are running higher than ever before ... and the future never looked brighter ... I look forward to every intelligent ... working man (having) a modest automobile.28

Of particular importance is Rutherford's emphasis on a 24-hour schedule with three eight hour shifts, last month's sales, current/previous year sales ratios, sales at this moment, and so on.

Such a statement is typical of the evidence for the assertion that short-run, tangible, operational factors generally outweigh considerations of a longer-run nature. In particular, in this period current sales, rush orders, inadequacy of overtime and extra shifts in meeting orders, dealers' stocks, manufacturers' inventories, and a desire to keep the proper "market share" motivated the acquisition of concrete equipment with which the firms would face the remainder of the 20's.

C. Product Diversification and Institutionalization of the Entrepreneur.

The period immediately following the 1920 recession has been given considerable space here in order to illustrate the basic pattern of investment-stimulating situations. It was chosen on the pragmatic grounds that no American trade journals exist
In a recent work, Katona has emphasized the difference between habitual responses to economic variables and those which arise from a new understanding of changes in the economic environment.\textsuperscript{27} The central problem in the description of investment expenditures, according to Katona, is to distinguish between habitual and non-habitual action. Non-habitual action requires that the actor perceive himself as facing a completely, or in major respects, new environment. The central problem is that of specifying the conditions which cause the entrepreneur to see data as requiring a different kind of action.\textsuperscript{28}

A. G. Hart has dealt at length with anticipations and reactions to economic uncertainty. His work will be summarized in greater detail in Chapter 2. The importance which he attributes to the role of expectations is apparent in the following passage.

In a time of high prosperity when most business is active and a great deal of investment in plant and equipment is in progress, investment is likely to be sensitive to bad news. In a time of acute depression, when most businesses have excess capacity, investment may be highly insensitive to good news or bad.\textsuperscript{29}


\textsuperscript{28} Contemporary communication theory would frame this question in terms of the degree to which "redundant" data define the responses open to the business man.

covering earlier recessions or depressions. Rubber firms of that period still bore the marks of their earlier beginnings in ways that are significant here. Firms did not have, e.g., the complex and institutionalized executive organization typical of their post-World War II arrangements. Their product lines were often less complex than today.

Rubber Age was founded in 1917. India Rubber World is an older and more international publication. While India Rubber World carries news of American firms it did not appear that an examination of say the 1907 recession would be profitable since the American industry was so limited then.

The course of the entire recession was not traced because a downturn in business is almost never reported in trade journals during its first phases. Recognition of recession signals appearance of articles predicting its end. These articles would be a credit to Voltaire's good Doctor Pangloss in their allusions to the "healthy readjustment" presaging a "certain recovery". There is no mention of the 1920 recession in India Rubber World until July although it began in May. In May the journal reported that "the story of Akron this year will be the expansion of the industry to the four quarters of the world." India Rubber World, Vol. 62, No. 2, May 1, 1920, p 524.

Rubber Age reported December 25, 1929 that the "Rubber Industry Looks for Prosperity in 1930" Vol. 26, No. 6, 1929, pp 310-12. Trade journals like the firms on which they report predict the continuance of good times or their early return. This is consistent with their role as "professional entrepreneurs." Cf. Chapter VII on professional entrepreneurs and finance economies.

In the Firestone Story, e.g., the historians for the company found it necessary to change the unit of account for production from tires and tubes to pounds because of growing complexity of the product line.
Synthetic rubber had not been made commercially feasible. Reliance on outside credit was still prominent especially in the light of their problems with natural rubber and cotton inventories.

In the post World War II period, large firms were engaged in expansion programs designed to establish their share of the market of a complex array of new rubber or plastic goods. Decision making by this time had become a matter of majority vote in Executive Committee meetings. Plant expansion accomplished the dual purpose during this period of keeping pace with competitors and diversifying product lines.

Investment expenditures were thus of a somewhat different character than those of the early 1920's both with regard to the institutionalization of the entrepreneur and the drive for diversification in the post-war market. Diversification had been proceeding for some time. This process enabled firms to grow and to increase their survival chances.

31. Cf. Chapter VII, where it is noted that while the chief executive of a firm is important, nevertheless the Executive Committee (whose most important members are officers of the company rather than Board members) makes major policy decisions in terms of a majority vote.

32. See the Firestone Story, also a report by the Akron Chamber of Commerce Bureau of Research, March 29, 1951 emphasizing the diversification of production and the fact that "manufacturing firms today are stressing expansion in new products." "The 'new look' in Akron's post-war make-up has been . . . Diversification." See Appendix A to Chapter IV for a reproduction of this report.

However, aside from increased opportunity for diversification and an increasingly complex situs of entrepreneurial choice, investment decisions turned on considerations remarkably like those of earlier years. The following accounts of expansion following World War II support this conclusion.

D. Post-World War Two

In the experience of smaller firms, that of the Wooster Rubber Company is particularly pertinent.

"Wooster Rubber Plant Addition"

"Wooster Rubber Company, Wooster, Ohio, has announced the construction of new plant facilities, including a two-story structure with over 52,000 sq. ft. of storage and shipping space . . . Expansion of company facilities is in line with the rise in shipments of "Rubbermaid" houseware. In the first quarter of 1950, these shipments were 106% above the same period in 1949. The rise continues the rapid growth of demand for the company's products since the war, which last year resulted in an over-all increase of 84%. Sales in 1948 rose 58% over 1947."34

P. W. Litchfield, Chairman of Goodyear Tire and Rubber Company announced in November, 1947, that post-war expenditures amounting to $100,000,000 would be made by his company to "keep pace with the expansion of sales". The dollar volume of sales was running three times pre-war volume being $600,000,000 compared with $200,000,000 pre-war.35 The United States Rubber Company

spent $25,380,257 on expansion in 1947\textsuperscript{36} and by September 1948 had spent over $80,000,000 on modernization, $50,000,000 of the amount on non-tire facilities.\textsuperscript{37} This ratio of non-tire to tire expenditure is indicative of the emphasis on diversification although the United States Rubber Company has always had a more diversified product line than other companies because they originally began operations mainly in non-tire fields.

The May 1949 issue of \textit{Rubber Age} carried a picture of the new Firestone Foamed Rubber Products plant at Fall River, Massachusetts costing $1,750,000 for meeting "steadily increasing demands."\textsuperscript{38} This site was originally purchased by Firestone in the late 1930's.

The Dunlop Rubber Company spent $654,000 for plant buildings and equipment in 1948 and this together with an increase in accounts receivable made bank loans necessary for the first time since 1941. The tone of this article reflected a reluctance to borrow on the part of Dunlop, even in these prosperous years.\textsuperscript{39} This is typical

\textsuperscript{37.} \textit{Rubber Age}, Vol. 63, No. 6, September 1948, p 753.
to some degree of all rubber firms since they were so dependent on banks in their earlier days and were almost constantly faced with money problems.\textsuperscript{40}

The General Tire and Rubber Company announced production of a "flexible tub" for Bendix at its Wabash, Indiana plant.\textsuperscript{41} And Firestone Tire and Rubber Company in the post-war period was planning expansion in view of the back-log of new car demand, postponed replacements, new industrial products, plastics, steel rims, and defense orders.\textsuperscript{42}

In January of 1946, Goodyear planned the construction of a $1,000,000 chemical Products Division Development Laboratory and a $3,000,000 Akron plant for the conversion of vinyl chloride copolymer and other resins into films, sheets and so on.\textsuperscript{43}

\textsuperscript{40} Cf. Beights, \textit{op. cit.}, on financial problems, also Harvey Firestone's \textit{Men and Rubber}.

\textsuperscript{41} \textit{Rubber Age}, July 1949, p 444.

\textsuperscript{42} \textit{The Firestone Story}, p. 364, 1946 - $23,800,000; 1947 - $21,600,000; 1948 - $21,600,000; 1949 - $19,157,000; 1950 - $28,000,000.

\textsuperscript{43} \textit{Rubber Age}, Vol. 58, No. 4, January 1946, p 487.
The General Tire and Rubber Company planned the manufacture of refrigerator and freezing units for the home with a million dollar factory in Morrison, Illinois.\textsuperscript{44} By October, 1946 Goodrich was building a five million dollar plastics plant at Marietta, Ohio,\textsuperscript{45} and the same fall Goodyear constructed a $4,000,000 tube plant at Gadsden, Alabama. In September 1947 Goodyear announced an expansion program totaling over $9,000,000.\textsuperscript{46}

As with other recessions, it is difficult to find in the trade journals any premonition of the 1949 business decline. However, one notes that the annual reports given early in 1950 by the major companies reflect some concern with financial problems.\textsuperscript{47} As was pointed out in the footnote, page 6 of this chapter, "lead times" on such attitudes would be difficult to prove or disprove.

Plant expansion had grown, of course, to significant levels during the last year of World War II. The entire burst of plant expansion during 1945 was not carried through in the manner planned.\textsuperscript{48} However, enough capacity was added so that had firms not turned to new and more diversified lines, excess plant would have been a problem.

\textsuperscript{44} Rubber Age, Vol. 58, No. 4, January 1946, p. 487.
\textsuperscript{45} Ibid., Vol. 58, No. 1, October 1946, p. 86.
\textsuperscript{46} Ibid., Vol. 59, No. 6, September 1947, p. 720.
\textsuperscript{47} Ibid., Vol. 66, No. 6, March 1950, p. 691.
\textsuperscript{48} Ibid., Vol. 56, No. 5, February 1945, p. 526. WPB authorized new plants which would have added 25\% to tire production capacity.
But the basic motive for expansion was that there were obvious sales opportunities which existing capacity could not meet. Market shares would have been lost; customers would not have been supplied. The firms took account of the general economic and political outlook; but they made their decisions on the basis of a pressing and clear-cut current demand for tires and new products.

E. The 1920's

This pattern of decision making was also followed in the 1920's. Its general nature is illustrated by reactions to increasing orders after the depression of 1920-21. These reactions

49. Cf. a statement by the B. F. Goodrich Company president, January 1949, who expected a good year because of current full employment at high wages, plant expansion throughout the economy, defense spending, foreign aid, and continued shortages. Rubber Age, Vol. 64, No. 4, January 1949, p. 492.

50. Companies sometimes created their own market, of course. For example, Neolite was marketed by the Goodyear Company.
reached a crescendo late in the 1920's after several generally prosperous years marred for the rubber companies only by price wars among themselves. This exemplifies the nature of the "redundancy" of information prerequisite to an investment peak although of course it reflects also the degree to which adequate capacity had been built in the first years following World War I. The signals for plant extension were consistently those relating to current successes.

"A new textile manufacturing plant producing both tire fabric and tire cords has been opened in Lowell, Massachusetts . . . running on a 24-hour basis (and) . . . as fast as it can be turned out production is being sold." 53

"Business transacted in the first seven months of 1924 was 65% greater than that done in the corresponding period last year. New machinery is being installed at the factory to increase production capacity by at least 25 per cent."

From "Mohawk Rubber Prosperous" 54

51. The problems of price cutting became apparent early in the 1920's. See Appendix A to this chapter.

52. This study suggests that Charades might be added to the economic game list. To musical chairs and poker might be added the charade in which all the syllables but one have been guessed and the whole party of persons shouts the last syllable. As soon as they shout, the game (investment) is over and a new game begins only after some time lag.

53. Rubber Age, April 10, 1924, p 12.

54. Ibid., October 10, 1924, p 11.
"To Let Contract for Second Servus Unit" describes the company as "enjoying a good volume of fall business ... evidenced by the receipt of orders thus far. Each day orders are booked for several hundred cases." 55

In December of the next year the Servus Rubber Company let a contract in the amount of $63,221 announcing that "we have orders on hand ... amounting to 21 car loads (to be shipped before January 1, 1926) in addition to many summer orders." 56

"As soon as the Wilson Rubber Company, manufacturers of surgeons' gloves, occupies its new four-story factory addition, it will increase production 35%. The Wilson company has been operating on a 24-hour schedule for many months." 57

"The Century Rubber Company, Wadsworth, Ohio, recently made small additions to its factory and has plans for a further enlargement ... officials say that the company is behind with its orders." 58

From the General Tire and Rubber Company Report, January 25, 1925: "We regret that we lost a considerable amount in sales because of limitations of factory ... in spite of the fact that we made three new additions ... within a year ... now ... we have three more additions under way." 59

Mansfield Tire and Rubber Company ordered a million dollars worth of new equipment because of "steadily increasing business" ... the new equipment enuf to "double capacity". 60

56. Ibid., Vol. 18, No. 5, December 10, 1925, p 151.
57. Ibid., Vol. 16, No. 2, October 25, 1925, p 35.
58. Ibid., Vol. 16, No. 5, December 10, 1924, p 145.
59. Ibid., Vol. 18, No. 8, January 25, 1925, p 244.
60. Ibid., Vol. 18, No. 1, February 25, 1925, p 321.
"Contracts have been let by the Goodyear Tire and Rubber Company for the construction of a five-story warehouse at Plant 2. the cost $750,000. additional storage space has been badly needed for some time. the last three months showed the greatest production in the company's history."

An operational definition of business "below expectations" is usually not practicable. One interesting inference drawn from the following passage is that in this case "below expectations" means below 24-hour capacity.

"The rubber industry entered the second quarter of 1926 in an optimistic mood as the result of substantial gains in nearly all lines. at the present time most of the Akron factories are working three shifts on a full-time basis. During February and March, the major tire companies operated on a five-day week schedule in many departments, and the small concerns reduced operations to three or four days a week. business in the first three months of the year was below expectations (italics supplied) (but) a large volume of orders is being received by local manufacturers with the result that stocks are rapidly being depleted."
D. Investment Expenditures and Capital Accumulation

Investment expenditures strongly influence deflationary and inflationary trends in the national economy. Another consideration, however, is becoming increasingly important. Firms often turn not to the stock and bond market for expansion funds, but to their own earnings. While these funds are not appropriated without reference to market rates of interest, or their best alternative external use, the discretionary powers of individual firms are broad. The appropriation of funds internal to the initiating firm is an important source of accumulation of real capital in the American economy. There is strong empirical evidence to indicate that most firms actually have an aversion to external financing. The widespread nature of this attitude leads to autonomous capital formation which partially "eludes an objective market test of the desirability of . . . capital expenditures." Dean states the case as follows:

"Ideally if a corporation paid out all its earnings in dividends, and then went to the capital markets for funds that it needed for internal investment, the flow of economic resources would be directed to the kinds of capital formation most needed, where need is measured by prospective profitability."  

31 Ibid., p 580.  
32 Ibid., p 583.
Technological provision for uncertainty is not easily defined in an operational sense, either. However, Rubber Age notes that since "shipments (were) above expectations, the Godfrey L. Cabot Company was building a new carbon black plant in Texas. "Plans have been worked out" the article states "to double the capacity of the plant on short notice whenever the state of the market justifies it."\textsuperscript{63} This is consistent with Hart's analysis of technology and uncertainty. Whether such considerations are predominant in most actual investment decisions is not clear from the evidence in trade journals. (Chapter VII indicates that they are not, exactly as Hart described them, but they are always important).

Basically, the description of action by the Seiberling Rubber Company below describes much investment action of this period, as well as others.

"The Seiberling Rubber Company has started at Barberton, Ohio, the construction of a two-story addition which will cost approximately $700,000. It was said by officials that the decision to erect an addition was made a few months ago when the normal capacity of the factory was by necessity (italics supplied) exceeded. Since that time, they declared, there has been no marked decrease in demands upon the factory.\textsuperscript{64}"

\textsuperscript{63} Rubber Age, Vol. 22, No. 5, December 10, 1927, p 255. Carbon black is used in the manufacture of rubber products.

\textsuperscript{64} Ibid., Vol. 20, No. 4, November 25, 1926, p 169.
F. The late 1920's

There were several indications in the late 1920's that the rubber companies faced serious problems. A number of smaller firms were showing losses, refinancing, or going into bankruptcy. Stock issues of rubber companies generally were not popular in Eastern financial markets. The price of crude rubber had dropped so far after the failure of the Stevenson Plan that some companies had lost heavily. While low crude prices made for lower costs, the risks were still great because of wide price fluctuations on inventory. Price cutting on finished products was widespread. And manufacturers' inventories of tire had been increasing for several years. (See Appendix B this chapter).

65. Rubber Age, reported in April, 1928, that Ajax Rubber Company showed a loss in 1927; Swinehart was refinancing, Mohawk Rubber Company had to obtain an $800,000 loan to solve their problems; Murray Rubber Company was refinancing. Rubber Age, Vol. 23, No. 1 April 10, 1928, p 38. These problems were those mostly of the smaller companies who were hard hit by the cut-throat competition of the industry. They did not necessarily portend trouble for the large firms.

66. Cf. Rubber Age, Vol. 26, No. 1, October 10, 1929, p 19. Rubber shares by October 10, 1929, had declined $300,000,000 from the peaks reached earlier in the year. "While this deflation is regarded as a technical correction of prices that had been forced up too high, it nevertheless reflects Wall Street's opinion of the rubber industry."

67. Goodyear wrote down inventories because of tire price cuts and crude rubber losses in 1928, turning, thereby, a net profit into a net loss of two million dollars.
However, plant expansion occurred at an accelerated pace during these years. This may be explained on the basis of two considerations. First, large Akron firms were finding it necessary to decentralize. Second, the consistently good years from 1922 to 1927 were having their effect once the industry had absorbed the capacity built during and after the First World War. Consistently favorable data were bringing appropriate investment responses. (This is the "redundancy" effect) Rubber Age devoted considerable space to a description of this expansion, in 1928.

Decentralization was imperative for a number of reasons. The multi-story plants of Akron are inefficient compared with one-story modern plants; something like decreasing returns to scale seems to be significant at the size of the Akron plants. Tariff barriers abroad led firms to construct plants in other countries. (The expansion to England occurred after the McKenna Tariff of 1927. Goodrich, Firestone and Goodyear built plants in England to avoid tariffs.) Important raw material markets are far from Akron. California was nearer raw material centers, and a growing market for finished products. The South offered new markets and lower wage rates. Goodyear built the first rubber manufacturing plant in the South at Gadsden, Alabama, in 1928 because of "native labor, nearby tire fabric mills, Southern tire market, fair tax rates, and low cost of fuel and power." Rubber Age, Vol. 24, No. 6, December 25, 1928, p. 312. Some sources connect influence from Sears Roebuck and Company with some part in this decision.

During this period, then, decentralization began. Firestone, Goodyear and Goodrich built plants in the West and South during the 1920's, particularly toward the end of this decade. Firestone in May of 1929 started a $4,000,000 expansion of their California plant in order to double production there. Cf. Rubber Age, June 10, 1929, p 251.

Labor problems in the 1930's probably increased this decentralization somewhat, but its basic nature was broader than an attempt to avoid unionization. This factor, is negligible today because unionization is so widespread. However, there is some evidence that companies look at the history of industrial relations and social conditions in a particular area before they build there, as is pointed out in Chapter VII. For an examination of the relationship of unionization to decentralization see Roberts, The Rubber Workers.
"AKRON COMPANIES SPEND $20,000,000 FOR EXPANSION"

"Extensive Building Programs Are Planned by all of the Leading Tire and Rubber Goods Manufacturers in Order to Meet the Increased Demand That is Taxing Their Present Capacities"

... "Despite enlargements of branch factories, particularly in Los Angeles, the Akron companies are finding more manufacturing and warehouse space a necessity" [Italics Supplied]

Specifically:

Goodyear, issuing new stock in the amount of ten million dollars, let a contract for a warehouse and possibly housing for the Goodyear Zeppelin Corporation.

General Tire and Rubber Company made an expansion to 50% greater than existing capacity financed out of earnings. The president of the company stated that a 200% increase was justified but could not be financed internally.

Seiberling planned to double its capacity in 1929."

Goodrich planned a new $1,500,000 warehouse.

"Unofficially it is said that all the other rubber factories in the Akron district, including Miller, Firestone, India, and Mohawk are planning to expand to meet increased demands for their products." [70]

Small and large firms shared similar views of the future in the late 1920's. [71]

70. Ibid., Vol. 24, No. 2, October 25, 1928, p 88 for these accounts.
71. Despite the fact that several smaller firms were unable to survive in the highly competitive industry.
"The plant of the Samson Tire and Rubber Company at San Diego, California, is now installing new equipment . . . the expansion is necessary due to the fact that the company has received additional contracts for its tires . . . according to the president of the firm."72

The Pharis Tire and Rubber Company, Newark, Ohio, started expansion "made necessary by increased business from old accounts and the addition of new dealers."73

Mansfield Tire and Rubber Company, Mansfield, Ohio, planned to "double capacity" since it had "outgrown its present facilities."74

Pioneer Rubber Company, Willard, Ohio, building a new structure because "increase in business had made the enlargement a necessity."75

In the Goodyear Company for the first six months of 1929, it was stated that for the first time in several years capital expenditures would exceed depreciation reserves.76

Canadian Seiberling was to expand because of the "remarkable sales increase" that Seiberling tires had enjoyed" in the two years since its establishment in Canada.77

73. Ibid., Vol. 24, No. 7, January 10, 1929, p 385.
74. Ibid., Vol. 24, No. 8, January 25, 1929, p 428.
75. Ibid., Vol. 24, No. 8, January 25, 1929, p 452.
76. Ibid., Vol. 25, No. 9, August 10, 1929, p 477.
77. Ibid., Vol. 24, No. 10, February 10, 1929, p 487.
In fact, the situation was one where there was little disagreement among industry representatives as to the course of the future. Perhaps it is a valid inference that dispersion of expected sales figures was decreasing through time. Early in 1929, industry leaders expressed this view in trade journal interviews.

A headline stated that "Leaders of the Industry (Were Showing) More Confidence Than in Twenty Years". This optimism was reportedly based on secular demand considerations, end of restriction, and the results of 1928. Rubber production in 1908 was 70,000 tons, in 1928 it was 700,000. (Data on manufacturers' inventories of finished tires are presented in appendix C to this chapter. There is a cyclical element present. Further discussion of this series).

By February 1929, Rubber Age was able to report that "Executives of the Leading tire and rubber companies in Akron and other centers are practically unanimous in their belief that the industry will experience another record breaking year, especially as regards . . . tires." If unanimity of opinion reflects a small dispersion of estimates in the view of the individual entrepreneur, than Hart's theory of the relationship between dispersion of expectations and commitment of liquid resources to illiquid form seems justified.

These last accounts indicate that the depression of 1929 was almost completely "unexpected". Further, its continuance was not foreseen although expansion policy was more cautious. For example, Goodyear increased the value of their fixed assets about as much in 1930 as in 1928 although the increase in 1930 was much less than that of 1929. Litchfield, head of Goodyear, diagnosed the situation as purely a stock market problem.91

In December 1929, Rubber Age devoted several pages to optimistic predictions by the industry's leaders. The article (with pictures and great prominence) showed that F. A. Seiberling, President of the Seiberling Company; F. R. Henderson, President of the New York Rubber Exchange; P. W. Litchfield, President of Goodyear Tire and Rubber Company; James D. Tew, President of Goodrich Company; and William O'Neil, President of General Tire and Rubber Company "looked for" increasing business for 1930.92

This might appear to be purposefully deceptive on the part of these executives. However, other evidence indicates that these statements were genuine. In Chapter VII, the interviews with company officials show that companies regularly predict the coming year to be at least the equal of the one just past.

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80. In 1928 it was $6,451,044; 1929 $23,736,722; 1930 $6,771,280.  
81. See Chapter VII.  
As late, furthermore, as November 25, 1929, Rubber Age reported that the B. F. Goodrich Company planned to expand their West Coast factory. T. F. Graham, first vice-president "expressed optimism over the business outlook for 1930." Rubber executives expected 1930 to be the "greatest year for tire renewal" yet. And, in fact, trade journal reports show that they began operations on the basis of this view. Production and activity in Akron during February, 1930, was reported to be as high as that in September 1929.

However, by late winter, reports of the effect of the depression on plant expansion were beginning to appear. B. F. Goodrich Company, expanding in November, decided by the last of February to postpone the building of their Atlanta (Ga) plant "until such time as our business and that of the rubber industry as a whole is such as to justify this expenditure." Plans for this building had been announced the preceding March, ground had already been purchased and first arrangements made.


84. Ibid., Vol. 26, No. 9, February 10, 1930, p. 477. "Production . . . believed to be running at about the rate of last September and October . . . about 60 and 65% of plant capacity."


86. Executive P.1 emphasized the fact that firms will not hesitate to abandon projects, temporarily or permanently, if they do not seem to justify even though money has already been invested in the expansion.
While there were scattered plans for expansion and ripples of optimism during the year 1930, Rubber Age reported in "Glance-Back Over 1930" that the biggest "surprise" and disappointment of the year was failure of the replacement market to materialize. The trade journals report few plans for expansion during 1930. Sales apparently were disappointing, especially renewals.

The recurrent hopes which the industry had are expressed by the general salesmanager of the United States Rubber Company's tire department.

This year (1931) he said "should be one of the most prosperous years business has known . . . sales for the first two weeks of January are satisfactorily ahead of the corresponding period for 1930 . . . considerable new business has developed and an increase has been noted in the replacement trade."

In a sense, of course, this was "whistling in the dark". The points noted here were similar to those of the 1920's but firms did not take this to mean that they ought to expand. However, this statement was an essentially honest one. Manufacturing executives typically expect "this year" to be better, however, they simply do not build plant unless there is a clear-cut need.

87. Rubber Age, Vol. 27, No. 7, July 10, 1930, p 375; for example had an article headed "Mansfield Tire Factories At Record Capacity".

88. Ibid., Vol. 28, No. 7, January 10, 1931, p 351.

89. Ibid., Vol. 28, No. 9, February 10, 1931, p 468.
Looking forward to 1931 and 1932 rubber executives continued to see some reasons for more business. However, they had by this time become adjusted and their thinking followed that of the president of the Norwalk Tire and Rubber Company when he said on December 25, 1931 that "over-expansion in plant capacity" was one of the two foremost problems of the rubber industry. And the head of the Goodyear Tire and Rubber Company could say that at the beginning of the year:

"There was a general expectation that the turn of the year would see a turn in business also. . . . we were consuming faster than we were producing . . . (but) fear spread across the country as to what Congress was going to do in the way of taxation. Business plans were halted, projected projects were deferred, the dollar went back into hiding."91

Thus, considerable time was required for executives to accept depression as being chronic. As theorists suggest, reactions to adversity are quick; firms will quickly call off or postpone investment projects, but they do not wish to accept such a state of affairs as being permanent.

90. Rubber Age, Vol. 30, No. 6, December 25, 1931, p 262. The other problem was that of fluctuations in price of crude rubber; this executive did not mention price cutting on tires.

91. Ibid., Vol. 31, No. 2, April 25, 1932, pp 62-3. This is one of the very few references to the effect of tax policy on expansion programs. Capacity was four times replacement demand in 1931-2; however, what effect tax policy had on modernization expenditures is not clear.
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While the rationing of capital inside a firm, concludes Dean, may be more expert than the rationing performed by capital markets, there is the plausible possibility that "sectors of the economy that need capital will suffer because sectors that have capital want to grow."¹¹ The question is basically one of how various expectations and attitudes may induce corporations to invest in enterprises whose rates of return are significantly different from returns reflected in capital markets.

E. Basic approaches to behavior in ambiguous situations

Economists have turned with increasing interest to the question of behavior under conditions of uncertainty. Contemporaneous with this activity on the part of economists, social psychologists have emphasized the relation of information to subsequent behavior.

A basic research study in this area relates to the formation of norms and answers in situations where no objective answers are possible. Muzaffer Sherif showed that individuals tend to write in their own frames of reference in situations of high ambiguity."¹³

Sherif used a previously established physiological phenomenon to demonstrate a tendency to structure experience

33 Ibid., p 584.
What investment there was during the 1930's falls in one of about three classifications. Some investment occurred as a response to the synthetic products which DuPont had begun to produce in 1931. This did not result in extensive new plant because the price of synthetic products was not competitive with that of natural rubber prior to World War II. (At least 75¢ compared with 15¢)

Other projects were initiated in an effort to lower costs, provide better service, and obtain a better competitive position in a time when sales were hard to make.

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92. The DuPont Company built a plant for the manufacture of DuPrene in 1931. The Dayton Rubber Company constructed a new building in 1934 for work on synthetic products. DuPont announced in 1935 the completion of a new factory for the production of approximately one million pounds of DuPrene annually. Non-tire products in the Firestone Company rose from 15% of business volume in 1930 to 30% in 1940. Rubber Age, Vol. 46, No. 5, February 1940, p. 309. By 1940 further new facilities were constructed at Deepwater, New Jersey by DuPont to produce 1,500,000 pounds per month. "The demand for Neoprene has been growing so rapidly in recent years that it has frequently been found necessary to start construction while the previous one started was still under construction" due to new uses being constantly developed. Rubber Age, Vol. 47, No. 2, November 1940, p. 114.

93. Cost-price theories of business fluctuations emphasize this motive in plant expansion. An editorial in Rubber Age, September 1932, listed 34 items of increased production, higher prices, or plant expansion, which were "Conclusive Proof of Business Revival." For example, they noted that lumber mills reported more business than usual, hog and cattle prices were stronger, United States Steel was planning a $5,000,000 expenditure for modernization. From the trade journal articles on the rubber industry, however, it is difficult to view this as a trigger mechanism in the cycle. By June of 1933 the companies in Akron were operating on a 6 day 24-hour schedule which was step by step "forced on rubber factories by general business conditions." Rubber Age, June 1933, p 121, italics supplied. And by early 1935 there was a shortage of used rubber manufacturing equipment in Akron. Rubber Age, February 1935 indicating some desire not to invest too heavily in modern plant.
A more important factor in expansion during this period was that of decentralization, partly in an attempt to escape unionization and high wage rates. Some of these investments are described below. It is significant that they were made mainly as a response to already increasing business rather than in the hope for better sales. Rubber Age reported "Akron's 'Big Four' on Heavy Schedules" with original equipment sales "far in excess of expectations".94 At about this time notice of expansion were appearing as follows:

Goodyear acquired a factory at Jackson, Michigan, "to be started on a limited basis and with a capacity of 5000 tires daily"95

Firestone purchased a factory at Memphis, Tennessee, for tire production.96

Ford Motor Company undertook to build a $5,600,000 tire plant in River Rouge after studying "the labor situation . . . in the tire manufacturing field."97

Goodrich opened a plant at Cadillac, Michigan for the production of rubber products for the automobile industry.98

95. Ibid.,
96. Ibid.,
98. Ibid., Vol. 41, No. 4, July 1937, p 261.
The Gillette Rubber Company in Eau Claire, Wisconsin, operating on a 24-hour day basis built two additions.\(^9\)

Firestone Tire and Rubber Company purchased several factory buildings at Fall River, Massachusetts, for the manufacture of latex products. This accomplished the dual purpose of diversification and decentralization.\(^10\)

General Tire and Rubber Company started production in March, 1937, on a new mechanical goods plant at Wabash, Indiana.\(^1\)

As usual, advance notice of the recession of 1938 is not given in the trade journal. Rubber Age only notes after several months of recession that the industry hopes for better business. However, in the late 30's there is evidence of further decentralization and diversification as well as some investment in synthetic rubber plant.\(^2\) This investment occurred in spite of a chronic overcapacity which prompted the President of the General Tire and Rubber Company to say in 1939 that rubber manufacturing business


\(^10\) Ibid., Vol. 42, No. 2, November 1937, p 125.

\(^1\) Ibid., Vol. 40, No. 6, March 1937, p 373.

\(^2\) A new mechanical goods plant at Clarksville, Tennessee, in 1939 by Goodrich was partly the result of a $60,000 gift of real estate by the city of Clarksville. Rubber Age, May 1935, p. 105. St. Oil of New Jersey began construction of a Buna S Plant at Baton Rouge, La., in 1940. Firestone began construction of a new factory in Akron for the production of Buna under a St. Oil license.
should be good because of the European war but "no plant expansion should be necessary as there is still sufficient unused plant capacity to provide for the greater expected demand."\textsuperscript{103}

Thus even during the depressed times of the 1930's, with volatile raw material prices, and price cutting on finished products, the industry yet "exhibited a strong tendency toward physical expansion."\textsuperscript{104} This expansion can be explained to a considerable degree during the 30's by the need to decentralize and take advantage of technological improvements.

I. Defense and War Years

Defense orders were beginning to be significant by late 1940. These orders "brought many plants to near capacity."\textsuperscript{105} Firms were not making large investments in synthetic capacity because, according to Litchfield of Goodyear, of the "relatively higher cost of synthetic rubber as compared to the . . . cost of natural rubber."\textsuperscript{106} A Neoprene plant at Louisville, Ky., was constructed by DuPont in 1941 with a capacity of 10,000 tons annually\textsuperscript{107} and the producer of Thiokol was erecting two new plants.\textsuperscript{108}

\begin{itemize}
\item[103.] \textit{Rubber Age}, Vol. 46, No. 1, October 1939, p 44.
\item[104.] Ibid., Vol. 48, No. 2, November 1940, p 108.
\item[105.] Ibid., Vol. 48, No. 4, January 1941, p 256 orders were let up to fifty million dollars.
\item[106.] Ibid., Vol. 48, No. 6, March 1941, p 414.
\item[107.] Ibid., Vol. 48, No. 6, March 1941, p 417.
\item[108.] Ibid., Vol. 49, No. 2, May 1941, pp 107-115.
\end{itemize}
By June, 1941, the government had made arrangements to finance four synthetic plants through the major rubber firms. And later in the year there were accounts of expansion into non-rubber defense work, e.g., ordnance, aircraft and so on. Wide product diversification is now characteristic of the industry although some of the products are not profit makers themselves.

World War II expansion in synthetic capacity was at a rapid rate, as is well known. Expansion of facilities for tire production were also, of course, joint decisions by industry and government. In 1943 Rubber Director Wm. M. Jeffers set 30,000,000 synthetic tires as a goal for 1944. Representatives of the rubber companies came to Washington with plans for a $95,000,000 expansion program to add new factories, mostly in the South and Southwest. They argued that had crude rubber been available, new plants would not have been necessary, but GR-S required more facilities. They further argued that plants in the Southwest would be near new markets and new sources of synthetic supply. Unions, fearing decentralization as a threat to their power, argued for plant expansion within existing walls. The decision finally was for a $75,000,000 expansion

110. Ibid., Vol. 49, No. 5, August 1941, p 339
111. As Heady, *op. cit.*, notes, whether this diversification produces less income uncertainty depends on the variance of the income from the added products and the first product.
program mainly for the improvement and extension of existing plants. Two new plants were approved in the Southwest and Goodrich later planned a new plant in Oklahoma.\textsuperscript{112}

This authorization for plant expansion was adequate apparently until the period near the close of the war. Early in 1945, WPB authorized new plants costing $70,000,000 which would increase tire capacity by 25%. Unions in this instance did not object to decentralization since they had membership in almost all geographical areas.\textsuperscript{113}

However, July 16, 1945, cancellation of these projects began and most of them were not completed.\textsuperscript{114} Had this last set of projects been completed, the companies might have found themselves with more serious problems of plant utilization after World War II.

\textsuperscript{112} Rubber Age, Vol. 53, No. 1, September 1942, p 533.
\textsuperscript{113} Ibid., Vol. 56, No. 5, February 1945, p 526.
\textsuperscript{114} Ibid., Vol. 57, No. 5, August 1945.
Chapter VII
EXECUTIVES' VIEWS ON EXPECTATIONS

Direct information concerning investment plans, their origin, realization or non-realization is limited. One cannot properly ask executives what factors go into investment decisions unless these executives have in mind specific decisions which were (or were not) made. The validity of such attitudinal measurement would be open to serious question and no critical statistical test is possible.

This chapter considers the interpretation which executives in the rubber industry place on investments actually considered and/or made in their firms in the past and their observations of the decision making process. The executives interviewed were not in every case at the highest policy level, but they have observed top-level decisions over a considerable period of years.


2. Validity of a psychological test refers to the measured attitude compared with subsequent behavior.

3. These executives had been with the firms they represented for from five to almost forty years. Katona suggests collection of data on sales, profits, liquid assets, and attitudes about the future from people in such positions. The types of information which he suggests are very difficult to obtain - partly because executives have little time for interviews, partly because firms do not wish to divulge such information, partly because the information does not exist. Firms do not look much to the past since their major concern is the future. In studying public utility planning, Gort found that written information at the top executive level was almost non-existent, though memoranda exist at lower levels in the corporate hierarchy.
The interviews were not highly structured. They were strongly oriented toward a free-response pattern, but the interviewer had worked out previously a multiple-choice set of questions. The situation was not, in the writer's view, conducive to attitude testing by the multiple-question, fixed choice method. However, he employed no strict method of coding the answers to his open-end questions so that the method cannot be recommended without reservation. The coding, generally speaking, was a reflection of the theory developed in Chapters Two and Three.

The interview method employed here, however, is consistent with the clinician's view that confidence between interviewer and respondent is a necessary condition for diagnosis. Since this is an area of controversy in another discipline, the point will not be pursued further here.

Several executives were interviewed with regard to the factors entering into a decision to enlarge existing plant or equipment. To preserve confidence, the officials interviewed will be listed by code only. The code key is available, on request, from the writer after clearance with the executive concerned.
Executive A, when asked about investment decisions in his firm, stated that while a formal arrangement does exist for the origination and approval of investment plans, nevertheless any attempt to trace these plans to their source, or determine the reasons for their approval or non-approval, would probably be unrewarding.

Plans for plant expansion or modernization do not occur at discrete points in time or department. Every department or segment of the firm constantly has plans for improvement and it is very likely that the department itself could not trace the germ of the idea back to its original source.

Further, when the time comes for the Executive Committee (which sits for any significant decision on plant change) to make a decision, each department through its spokesman has large amounts of information, facts, figures, and models which supposedly argue for the department’s chosen project. The result is that more plans are presented than can possibly be used, and more importantly for us, more information than can possibly be used. Each department expects that it will be successfully challenged
on several of its points. But this is all part of the game. 4

However, Mr. A did make several comments which are very significant with respect to the theory developed so far. These points are not presented in the order in which he mentioned them, but in a manner consistent with theoretical considerations.

The firm, through its department heads or spokesmen, and its Executive Committee (the chief seat of power, the President of Chairman of the Board being unable to overrule it) does not ever predict a severe recession for the fiscal year for which they are planning. The Committee has sales estimates (based on market research techniques) which set the base for next year's plans. Usually they do not count on, in terms of plant expansion, a large percentage increase in total sales. The extent to which this assumption is formalized and articulated is probably variable.

This indicates that the predicted status of sales and the movement of goods is one of the chief factors in making decisions on plant expansion. This was stated about as follows: "When a firm is making money, investments occur. If losing, it is time to find out where the firm is losing before extending

4 Paraphrased somewhat, this was stated as follows. During a meeting of the Executive Committee it is good policy for a department partisan to "swing in all directions in order to influence votes." This, the reader will recall from McDonald, is good game strategy since one's actions, in extremum, would be completely unpredictable. Obviously, this strategy is not meant to be carried to extremas.
irrespective of objectively available signposts. Research in visual problems had demonstrated that individuals, confronted with a stationary pin point of light in a completely darkened room, will feel certain that the light is moving. This is known as an autokinetic effect. Sherif showed that not only do they perceive the light to be moving but that they improvise standards by which to judge the extent of movement. When in a group situation these "standards" are likely to change in the direction of some group estimate or standard. Sherif's conclusion is that the experiments demonstrate a general behavioral tendency for a need to structure one's experience even in an "alone" situation where there are no objective answers, and to modify standards in the direction of group judgment.

A similar situation is that in which answers to problems exist but their temporal presentation is such that right and wrong responses are randomized. Faced with this situation, an individual could not "learn" correct behavior in the sense of reducing errors prior to goal attainment. The solution to each problem depends upon considerations of chance alone. What will individuals do in situations where correct behavior cannot be "learned"?

They may, of course, become neurotic and incapable of any stable reaction pattern. Some experimental evidence in
commitments."

In addition to current sales and business, the other important influence mentioned was the need to innovate or imitate to keep up with competitors. A most important consideration is to keep one's share of the market, and of course, to steal as much from one's rival as possible. (It should be remembered that the rubber industry has always been highly competitive, both price and product-wise.) The representative of firm A could not state too strongly the need to be abreast of current innovations, and if possible to lead the field.

With respect to innovations two rather significant points were made. One was to the effect that the labor/capital ratio is very important in Akron and that anything which tends to decrease the cost of labor (i.e., decrease the man-hours required for finished product since the wage rate is rather uniform through collective bargaining) will likely be looked upon as a desirable improvement. Historically, this has been very true of the rubber industry, as attested by the increase in labor productivity in the industry. 5

Second, there is no hesitation in stopping an investment in new machinery or plant expansion even though "bricks are being laid, money has been spent, real estate bought, and so on." 6

5 See Chapter Four on technological change and labor productivity.
6 One account of the development of this company notes that on at least one occasion a new factory was built but "stood idle and unequipped."
If the project does not appear to be working out, for some reason, it is dropped without a backward glance. Thus one infers that most modernization in the rubber industry, contrary to Terborgh, occurs without backward glances.\(^7\)

This is closely related to the point that if depression or recession occurs, there is little delay in retrenchment. In other words, the firm assumes for at least a year ahead that there will be no drop in National Income (and no big disappointments for them) but if there is one, the adjustment will be almost instantaneous.\(^8\) This confirms the thesis advanced by Shackle and Hart concerning asymmetrical reactions to surprise.

However, it is more difficult to find empirical support for Hart's thesis than for that of Shackle from this interview. First, with respect to innovations, the firm does not place as much emphasis on flexibility as would be inferred from Hart's analysis, as outlined in Chapter Two. That is, the firm does not pick some plant or machine design best adapted for flexibility. It picks what it thinks best at the time and if the selection is wrong, the firm abandons it without official grief, although certain individuals within the firm may be disappointed.\(^9\) However, it should be noted that another executive (Mr. Z\(_2\)) pointed out

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\(^7\) The firm does employ a highly trained historian but his function is not that of helping with current decisions.

\(^8\) The lag might be a few months, due to the delay involved in obtaining an accounting summary of the firm's luck. Also, with respect to finished goods inventories, there is some delay in adjustment (See Appendix B, Chapter VI).

\(^9\) Flexibility is achieved by letting each venture remain "on trial" constantly.
some specific instances where Hart's thesis is borne out
(for example, in the acquisition of more real estate than
is currently needed).

Second, it is difficult to think of such a thing as dis­
persion of expectations increasing through time. Actually,
the firm seems to do what a majority of the Executive Committee
thinks best at any one time. Shackle's theory more aptly
describes this situation in terms of a focus-outcome.

Executive A indicated that the comptroller's office
plays an important part in expansion plans. He indicated that
the influence of this department was felt in every other,
which seems to indicate that the financibility of a project
is a key point.

Firm C

Company C has a well-defined system for the approval
of capital expenditures, although as with Firm A these proposals
originate in varied areas of the firm's structure. Projects
originating in various departments or divisions are summarized
on a form known as an "Executive Authorization." This form
goes through regularly designated channels for approval cul­
minating finally in the Appropriations Council composed of
high-level officials.
Mr. C₁ indicated the general background against which the Appropriations Council reviews such requests. Dominant considerations in decisions since 1940 have been increasingly of a long-run nature. Sales forecasts for the succeeding ten years are available. Sales forecasts for this period take account of population changes, changing age groups within the population, real gross national product trends, passenger car registrations, replacement tire shipments, motor vehicle production, gasoline consumption, and other factors. Certain departments in the firm have been attempting to develop interest in long-range planning and it is known that the President of the firm is sympathetic with this point of view.

The planning horizon is more accurately characterized, however, as being about three years. Forecasts of profit and loss for the next three years based on prospective capital expenditures (and accompanying capital costs) and sales for the three-year period are prominent features on this horizon. Although there has been some progress in attaining a greater degree of long-range planning, certain short-run factors remain as essentially dominant considerations.

Mr. C₂, for example, indicated that the firm would be

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10 Mr. C₁ has been associated with the firm since about 1930.
reluctant to spend money for a temporary "bulge" in sales and business activity. Significantly, Mr. C2 outlined a procedure equivalent to Andrews' analysis in Manufacturing Business which the firm employs to meet expanding sales. The firm makes "every effort" not to expand more than necessary. A 24-hour 7-day schedule is the first adjustment. If necessary, the firm next considers expansion of existing facilities. New plant is generally the most latent response.

Delay in expansion is not ordinarily due to a desire to take advantage of lower costs at a later date, according to Mr. C2. If a project will clearly pay in the view of the Authorizations Council, or if it is necessary to maintain the firm's market share, usually it is begun without waiting for lower costs. This is, again, contrary to a strict cost-price interpretation of the business cycle.

Some delay occurs, of course, when there is doubt, in the collective view of the Council, whether a project should be undertaken. Mr. C2 stated that if there was "lack of consensus"

11 See Chapter Six.

12 Executives C1-C3 were unanimous in suggesting that firms cannot remain stationary. They placed great emphasis on investment in innovations, and expansion to meet a growing population of changing age groups. This is "autonomous" investment. Repeatedly in the interviews it was pointed out that firms must constantly be making investments in new directions, particularly where a firm is large and has heavy overhead expenses. These overhead expenses must be carried to some extent by profits from innovations.

13 Of course, inter-firm reactions are not directly predictable from observations about one or a few firms.
among the members of the Council, then they would "wait."
The firm follows the dictum of statistical decision making in minimaxing their regret since they do not try to minimize the maximum loss.\(^{14}\)

An important exception to this procedure occurs when the firm obtains the technical means for a "new product" which the firm feels it must exploit. Given the possibility of a "tubeless tire" the firm considers itself compelled to follow through with an innovation, or to imitate their competitors. Such "autonomous" investment occurs in any phase of the cycle although the extent of new plant will vary depending on the state of business activity.

"Induced" and "autonomous" investment are expressed in Firm C by attempts both to increase clearly inadequate capacity and at the same time to engage in long-term planning which will exploit in the most profitable way new products as they are developed. Executives in Firm C corroborated the conclusions drawn from trade journals and other firms, in this regard.

Representatives of this firm extended, however, their descriptions of investment action to include some of the factors

which enter into nearly every decision. They pointed out, that as in other firms, department heads are continually presenting new projects and vying with other executives for an allotment from the capital budget. Further, when the Appropriations Council, and later the Executive Committee, attempt to decide which projects they wish to authorize, they must make their decisions in the light of the firm's basic "philosophy." Firm C does not wish to be the largest firm in the industry or to have the largest volume of sales. Its goal is a maximum dollar profit.

This raises the question of rate of return on proposed plant extension. Generally estimates are made of the return on total finance capital employed to complete the new venture. This would include money used for working capital, inventories, receivables and so on. Even this does not yield a clear-cut answer concerning the final effect of the extension on the firm's life since it leaves ambiguous questions of how to allocate income to stockholders vis a vis others, or how to account for the high rate of return on pre-war investments (with an initial low price) as compared with post-war investments.

For each project the top executives want 1) sales estimates

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15 Mr. C confirmed a statement by Talcott Parsons to the effect that much of the "competition" in a modern industrial system is intra-firm competition and that there is a professional drive among executives similar to the professional motivation found among doctors, clergymen, teachers, or lawyers. Parsons, Talcott, Essays in Sociological Theory Pure and Applied, Glencoe, Illinois: The Free Press, 1949, pp 213-15.
2) estimates from factory technical personnel on capacity
3) estimates from engineers on alternative construction or manufacturing methods
4) available funds studies
5) estimates of the pay-off period and
6) alternative tax obligations under different proposals.

Firm C employs an interesting precautionary scheme in the event that conditions become unfavorable. Sales forecasts, Mr. C₁ stated, are on an optimistic basis. They are estimates of the firm's success if "we work hard and get the breaks." Sales estimates are discounted 20% and a profit and loss statement computed on this basis. Estimates of the firm's position are made assuming that sales fall off this much and a plan is made for retrenchment if such a situation arises. This procedure would facilitate asymmetrical reactions to surprise as outlined by Shackle.

Executive C₃ reenforced the conclusions reached from trade journal reports and previous interviews. Mr. C₃ occupies a position in Firm C which makes it necessary for him to take account of business expectations. His opinion was the result therefore of previous thought and study of the question with respect to Firm C.

Expectations, he thought, are a function mainly of recent
sales experience and predicted sales. Swings of optimism and pessimism not so closely related to sales might have some effect on inventories of raw materials and goods in process. This has not been studied so far as Mr. C3 knows. But expectations have no more esoteric meaning than the extrapolation of recent sales, in his view.

The rate of interest is relatively unimportant in Mr. C3's observations. What is important are the questions: How much money is needed? How much has the firm available? Where will the remainder come from? How soon will the money return?

Cash availability is a critical factor. Available funds studies are constantly being made and contemplated expansion projects are balanced against them.

Mr. C3 also pointed to the tendency for capital depreciation allowances to lag the price level. When this occurs over a long period of time (for example, 1939-52) considerable amounts of available funds may accumulate. This would depend of course on the write-off period, dividend policy and other factors. However, this might be a factor in the accumulation of reserves for business spending which would slow down a business recession.

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16 Mr. C3 viewed manufacturers' inventories as unintentional inventory investment.

17 Cf. Katona, George, op. cit., pp. 249-50, where the question is raised whether interest is not still rather important.
Mr. C2 had previously stated that available funds studies currently indicate that if business starts down, it might "wind down" slowly.

Increased availability of corporate funds, and the inherently optimistic bias of the "professional entrepreneur" do not make for a "musical chair" economy.

Mr. C2 further emphasized the importance of the fact that "expectations have a history." Firms do not come up to investment decisions "cold." Each project has a long history and is undertaken only after careful advance planning. Theoretical analysis generally fails to take account of these expectational antecedents. Further, firms plan on the basis of rather concrete considerations, he noted, not because they are unaware of more remote possibilities (for example sharp change in consumer psychology, changing international situation) but because they do not have a knowledge of them sufficient for planning purposes.

Firm Z

Financial arrangements for a firm are likely to be most adequate when they are made with a mental complex of disaster, according to Mr. Z2. Mr. Z2 is a highly placed official in Firm Z and he has been associated with its financial policy for over thirty years. He emphasized the importance of bank credit
comparative psychology leads us to believe that even in these situations complex organisms will engage in stereotyped behavior, showing significant consistencies and stability. This behavior will not reduce errors but the same pattern of action does lead to goal attainment and reduced tension.

The evidence with respect to behavior under extreme motivational conditions (for example fear for life, extreme hunger, rejection by others) and/or a goal which is an impossible one in the light of the organism's behavioral repertoire, is not as helpful as other studies. The findings of comparative psychology encourage us to look, however, for consistencies in human behavior in diverse, unstructured, and ambiguous situations.\(^{35}\)

These consistencies are partly the result of cultural and societal conditions. The same stimuli produce different reactions in many areas of human activity, depending upon prior conditioning of the culture in which one lives.

However, there is evidence for the assertion that individuals do structure their experience in terms of a meaningfully small number of variables, even in intra-cultural situations. Bartlett studied the effect of oral transmission on stories.\(^{36}\) Generally the result was a simpler, more

\(^{35}\) This encouragement is a function of acceptance of "field theory" in psychology, a course which a strict behaviorist would criticize.

for survival, since two things happen to "money." First, the interest rate rises and falls although this is not of great concern to the firm. Second, money "disappears overnight," and this is more important. In order to provide for such a situation, the firm (mainly through the efforts of Mr. Z_2) has insured itself for a significant line of credit with a group of banks. By paying a small premium to a group of banks, the firm is assured of a generous line of credit for up to five years no matter what turn business takes. This is available "if the unexpected happens," because bank relations are an intricate matter and the best credit risks are likely to be refused the day after (or of) a crisis.\(^{18}\)

The problem of adequate outside finance was discussed in its relation to the procedure by which the firm makes its decisions on plant expansion. Annually there is provided in Firm Z, about the year-end, a capital budget providing for Necessary Expenditures purely for maintenance of existing plant and Expansion Expenditures, for new facilities of one kind or another. The yardstick for the "Necessary" expenditures is that they must not exceed the depreciation reserves provided in accounting terms. The criterion for appraisal of the "Expansion"

\(^{18}\) Cf. Roy, A. D., "Safety First and the Holding of Assets," *Econometrica*, Vol 20, No 3, July, 1952, pp 431-449. Mr. Z did not infer of course that officials are overwhelmed by the thought of a catastrophe so that all action is centered around "provision for the worst," but merely that provision for adverse events is a prerequisite to survival.
expenditures is a comparison of the following: Available Funds (from total consolidated depreciation funds plus estimated re-
rained earnings after dividends) and Total Projected Expenditures (Necessary plus Expansion Expenditures). If there is a balance
between these two totals, then the firm does not have to "dip
into" working capital. In this case, the Board of Directors,
which approves the capital budget in general, would be less
likely to raise questions about the total of the proposed capital
expenditures than if proposed expenditures exceed estimated
available funds.

If proposed expenditures exceed estimated available funds,
questions are raised about the state of the firm’s working
capital and how the firm would go about raising the extra funds.
This is a serious question for Firm Z, and there is a presump-
tion against debt in the collective attitude of the officers and
directors. Currently, however, tax credits from the federal
government for debt and for capital expenditures are such that
the firm obtains money "for less than nothing." That is, the
firm certainly cannot afford to finance expansion through common
stock; and, as a matter of fact, cannot afford from a tax point
of view not to expand.

The capital budget is reduced to documentary form and given
a title here fictitiously referred to as "The Budget Book." This "Book" goes to the Board from month to month, and if a
project is included in the book, it is likely to be approved
assuming cash and profit and loss estimates come close to
previous predictions. If a project is presented in mid-year
and has not previously been included in the "book," it is
subjected to close scrutiny by the Board and it is very un-
likely that it will be approved unless overwhelming reasons
are given for its existence.
Once the capital budget has been approved by the Board of Directors, the basis is laid for an estimated profit and loss statement for the quarter ahead and for a cash budget estimate for the next six months. A corporation, in particular Firm Z, knows six months ahead what position it will be in at that time, according to Mr. Z. Thus, since the proposed capital expenditures for the year are only approved in principle at the beginning of the year, and funds authorizations are required from month to month for specific projects, an automatic check is provided for controlling these expenditures if the firm's expectations are incorrect.

Cash estimates are revised each month and carried forward six months and profit and loss estimates are made for each quarter. For episodic phenomena (for example, Korean conflict, money panic) the finance division brings all accounts up to date and forecasts cash and profit and loss and balance sheet items for a year ahead. And the firm revises its plans in the light of this information.

Thus sales and profits from "yesterday" (either last year or last month) are enabling factors in investment decisions. Available funds set a limit beyond which stronger motivating forces are required for investment decisions. If adverse conditions occur without warning, the firm is quickly able and willing to revise its actions and reduce commitments. Further it has
various "cushions" of finance "confidential to the officers of the firm) on which it can rely in emergency. This is reflected in the revolving loan fund mentioned above.

If the capital budget is less than estimated available cash, this means "trade is low" and the firm will retire outstanding securities unless there is a liquidity scare throughout the economy. Firm Z, consistent with previous findings of this study, thus follows the state of trade rather than attempting to "lead" it. However, the firm, through careful advance planning, attempts to follow very quickly in point of time.

The procedures outlined by Mr. Z exhibit the factors which set limits to the rate at which capital expenditures flow from the firm over time. On the other hand, what forces induce executives throughout the firm to initiate requests for capital expenditures and to state their case so strongly that the Executive Committee of Officers and the Board of Directors approve the requests? As Mr. Z pointed out, a wide variety of motives enter here. These perhaps can never be summarized in any simple easily understood pattern.

However, one general statement seems to be valid. Plants are built, machinery is added or replaced only "in response to markets for the final product, or indications of a market."

20 Mr. Z holds an important post in Firm Z and has observed decisions at the highest level of policy for more than twenty-five years.
Often an innovation in product will indicate possibilities for future sales. Mr. Z\(_1\) was able to list seven or eight instances of this type of investment, and there are numerous others. Fairly frequently a change in production techniques will bring about investment in new equipment. A desire to protect the firm's market share of a growing market (or perhaps of a tighter market resulting from business recession) will also invoke investment action. Any "good" firm will have more places to invest money than it has available funds, according to Mr. Z\(_1\). The limit seems to be set by available funds and the firm's access to, and willingness to obtain, debt or equity finance.

Theoretically, this type of investment may be categorized as "autonomous." It is an extremely important investment category to the total economy in terms of innovational activity and secular growth. The specific direction of this innovational activity (for example, the particular new product or technique or market source) cannot be defined in advance, although much planning goes into any project which the firm undertakes.

Completely new and unexpected directions of development are opened up by investment in this category. Mr. Z\(_1\) feels reasonably certain that the firm has lost money over considerable periods of time on a new product. This new product must, of course, be "carried" by the company's other activities. Certainly this is an important justification for internal financing
particularly where the introduction of a new product is involved. Generally it seems correct to say that commercial banks would be upset by consistent losses in the development of markets for new products if the firm were to turn to this section of the money market. Further, Mr. Z2 indicated that (from his own personal experience) underwriters and investment banks are reluctant to take chances. Indeed, it was Mr. Z2's observation that underwriters have become mere agents rather than risk takers. The money market, in its various ramifications, has not been noted for its ability to carry projects at a loss in order to develop them later as consumer goods.21

The amounts available for "autonomous" investment will be a function of secular growth in demand, innovations, and fluctuations in national income, as well as of other factors. Firms will never be able, however, to supply all the funds requested by divisional chiefs within the firm for the expansion of particular departments or projects.

From the theoretical point of view, again, part of the investment in Firm Z is "induced." The view that "induced" investment is a useful conceptualization of investment in Firm Z is supported by two kinds of arguments. First, the availability

21 Charles Goodyear spent considerable time in a debtors’ prison for his innovational efforts.
of funds constitutes, as seen in the comments made by Mr. Z₂, a kind of "threshold of awareness" of the possibility of pursuing the projects suggested in various departments. Increased available funds will "lower" the threshold; fewer available funds "raise" the threshold beyond which projects can be thought of as possible.

Second, Mr. Z₁ pointed up as did other executives, the important relationship between plant capacity and the status of orders and back-logs of orders. An important type of plant expansion is that which occurs when the firm is operating on a 24-hour day, 7-day schedule and is still behind on orders. Although this is a very important and fundamental principle on many occasions (often overriding), Mr. Z₁ made it quite clear that investment decision making is a very complex process. Within the interviewer's more narrow conceptual point of view, however, Mr. Z₁ did agree with the hypothesis that this is an important investment category.

A corollary to the theory of induced investment is that as business quickens, the firm must be sure to get its "share" of the market. This is illustrated by the importance of the sales forecast and the question of how much of the total sales in the industry one's own firm will obtain. The Sales Research Department in Firm Z estimates sales for the coming year in the following
fashion. Number of cars currently on the road two years old or older are added to the number estimated to be built, combined with a consumption factor of tires per car. This figure and manufacturers' inventories, shipments to dealers in the current quarter, dealers' stocks, rubber on the ground estimated by a national sample of tires checked by technical men as to condition of tire and brand (the biggest inventory of tires is that of those currently on cars), are all combined in a formula, and used with considerable judgment to predict sales for the next year.

Once the industry sales forecast has been made, the next question is - how much does Firm Z expect to sell of this market? This figure is a somewhat conventional percentage. It is never less than the firm's historical share, and it is probably the firm's historical share plus a small additional percentage. This determines the firm's goal for the next year in tires. Somewhat similar procedures are followed for the many other products the firm produces but the analysis is more complex. Once the firm's quota is arrived at, sub-quotas are allocated throughout the country and this "determines capacity considerations."

Mr. Z stated very clearly that the three most important features of dynamic business operations were: 1) percentage profit, particularly as compared with other firms 2) cost be-
behavior and 3) share of market going to the firm. Thus, investment may occur as a response to the success of rivals. Or it may occur as an effort to reduce costs (this was noted by Mr. A, who emphasized the importance of the labor/capital ratio in cost policy).

Long-term development is consistently a part of the firm's planning. As with other firms, data on car registration and population in the next ten years are always under consideration. The firm employs at least two devices for meeting its long-term needs. First, in building tire plants (tires are still the most important production), the firm builds for the present but constructs a plant layout flexible enough for expansion. For example, more land is purchased than is currently needed, a power plant in excess of current needs is constructed. Mr. Z's description of this method of adaptation tallied exactly with A. G. Hart's theoretical development.

Second, with respect to other products, the firm seems to employ a strategy of putting a considerable amount of resources into the creation of a few new products (and the demand for them) even at a loss in order to remain as one of the leaders in the industry. It was the interviewer's impression that most products have to pay their way on a more or less current basis but the firm is willing to do much planning and risk large amounts of
money on a few products which give promise of future development. Thus development of a few new products (even at a loss for a period of time) and diversification of production seems to be the long-range strategy of Firm Z for non-tire production.

During the post-war period, for example, with a considerable experience in synthetic rubber production (essentially plastic production) the firm set out to diversify its product line particularly in synthetics. The firm engaged in aggressive advertising and selling campaigns in several areas where there was no history of past sales to give them confidence. Mr. Z stated that much of the equipment for the production of these articles was highly specialized. This would contribute to the uncertainty surrounding the venture, as Hart has pointed out. The interviewer felt that had not sales in other lines been so large in the post-war period that these campaigns and production of new specialized products might not have been undertaken on such a significant scale (effect of induced investment smaller) but the company would certainly have entered such areas to some extent.

As was pointed out in Chapter Three, one broad factor in any firm's investment pattern is merely the industrial and social

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22 Mr. Z did not confirm Heady's theory concerning selection of products whose variances of return through the years show inverse correlations. Firm Z picks products adaptable to its technical abilities although there is some effort to overcome seasonal variations by complementary products.
coherent and culture oriented story. Bruner and Postman showed that perception depends upon value and need, using reactions of hungry versus satisfied children to sight of food.37

Allport and Postman have been particularly successful in their study of the psychology of rumor. They conclude:

"Whenever a stimulus field is of potential importance to an individual, but at the same time unclear, or susceptible of diverse interpretations, a subjective structuring process is started. Although the process is complex (involving, as it does, leveling, sharpening, and assimilation), its essential nature can be characterized as an effort to reduce the stimulus to a simple meaningful structure that has adaptive significance for the individual in terms of his own interests and experience."38

Essentially perception is a process of simplification, of structuring, an otherwise unstructured experience around previously meaningful concepts. It is an effort to understand and give meaning to the problem situation.39 The factor dimensions of major importance should be capable of diagrammatic representation, if properly summarized.


39 Current communication studies have shown, however, that memorization may depend as much on grammatical form as on meaning.
milieu peculiar to the individual firm. This is what makes generalization so difficult, as Mr. Z noted. As examples of the wide variety of motives for plant expansion, Mr. Z noted some of them as follows.

Plant construction in foreign countries was largely a response to import duties and the danger that the company would lose its "share" of the market in those areas. The timing of these investments in new plant turned in great measure on the introduction of protective tariffs in those countries.

Plant construction in this country turned on various other considerations. In moving to the west coast, the firm was taking advantage of a growing market where freight costs from Akron might make a substantial cost difference. It was also taking advantage of the coast's proximity to natural rubber supplies, its then adequate water facilities, and other factors. In moving to mid-western locations the firm was again thinking mainly of freight costs although adequate labor supply and other factors were important. In still other moves, the firm was adjusting to changing market structures brought about by population movement, increasing industrialization (for example in the South), and so on.

These few paragraphs indicate the importance of the particular social and industrial milieu in which the firm operates, or
Summary

The factors affecting investment decisions, as inferred from representatives of Firms A, C and Z are as follows.

First, the necessity for expansion brought about by the inability of present capacity to keep up with current sales. This is the induced investment situation, as seen in the behavior of the firm.

Second, dynamic features of the firm’s adjustment to a changing environment. This includes the need to keep one’s share of the market or it may relate to innovations designed to lower costs of production. This is the autonomous investment situation.

Third, the milieu in which the firm operates. Its own peculiar history and its own present equipment which is after all the only valid link the firm has for connecting its future to the past.

Fourth, the importance of available funds cannot be overemphasized. The level of available funds constitutes the threshold beyond which projects are seen as presently desirable or postponable.

The attention the firm gives to such items as current sales,
dealers stocks, its share of the market, cost-price relations and so on, is not matched by its attention to the state of business confidence generally, or whether the future will be bright.

Does this mean that expectations are a "will of the wisp" manufactured by theoretical economists and financial page analysts? Partly. However, the writer offers the suggestion that Lord Keynes had this in mind when he distinguished between the "professional entrepreneur" and the finance economy which manages to play such tricks on him.23 Expectations are more critical in a system characterized by the opportunity to move quickly into or out of investments. This is the broader picture connoted by activity on stock and money exchanges. However, with the decreased importance of the stock exchange and the increased availability of corporate funds, the "professional entrepreneur" may become more important as an expector, a turn of events not without certain advantages in the light of the preceding analysis.

23, Keynes, J. M., General Theory, pp 147-164.
Chapter VIII
SUMMARY AND CONCLUSIONS

The theory of expectations is essentially the theory of behavior under incomplete information. While incomplete information is a characteristic of all human experience, the ambiguities facing firms in a generally individualist economy are important for two reasons. First, the volatility, or sensitivity, of private investment is an important factor in the trade cycle. Second, capital accumulation depends upon the joint actions of firms, individuals, and government; and private concerns are becoming more and more important as collectors of capital funds for construction of new plant and equipment.

Although there is a considerable literature on the theory of behavior under uncertainty, much of it has been written without reference to certain findings in the area of social psychology where situational selectivity of perception has been emphasized. This study has been made with the idea that entrepreneurs' actions will have only a partial objective
explanation, much of their action depending upon their perception of the economic environment.

Their perception of the economic world will be structured around a relatively few simple, operational, concrete, and meaningful factors. The important variables selected by important decision-makers within firms should be tangible items with which they are very familiar, for example, sales and inventories.

As modern statistical inference phrases the question, any investigator faces the problem of knowing when further sampling of information will be profitable. Consistent with this view is the description of the entrepreneur (here meaning, usually, the firm acting through the collective decisions of its officers and directors) as he pays particular attention to his available funds in comparison with proposed expansion expenditures made by various departments within the firm. Consistent with the Neyman-Pearson-Wald formulation of the sampling problem, the entrepreneur will be matching expansion opportunities against available funds (internal or external to the firm) with his eye on sample estimates of sales, backlogs of orders, new production techniques, plant capacity, new products, and a few other variables perhaps peculiar to his firm.

According to the view of Katona (and in a sense Keynes, at an earlier date) the entrepreneur will find it difficult to
come to a new understanding of his situation. He will proceed usually as if "tomorrow" will be like "yesterday" within the constraints, of course, imposed by the capital equipment which he now has from yesterday's efforts.

As the entrepreneur attempts to move out in one direction or another, he will attempt to "minimax" his regret. That is, he will examine the alternatives open to him for each proposed venture and estimate maximum possible loss for each alternative. He then, conceptually, selects the minimum of these maxima.

In practice, the operations which achieve a minimax solution are those of taking some intermediate position between the greatest and least possible gains and retaining his flexibility so that he can make new moves when additional information comes in. If this new information, when it comes in, is surprising, the initial effect will be to cause some delay in action even when the "surprise" is favorable. This is what Katona meant when he argued that a new understanding of the environment is only an occasional occurrence.

If similar events continue to occur with considerable regularity and consistency, then the entrepreneur is in the situation of the statistician when the sequential probability ratio begins to converge toward some limit. He feels that he is in a position where further gathering of information will not be profitable, and so he takes some action, either an investment
or a non-investment response. This situation is described in communication theory as "redundancy" of data sufficient for the prediction of the remainder of the sequence. This is perhaps the conceptual explanation of the "flurry" of investment activity in 1928-29 in the rubber industry and in the economy generally. However, the "trigger" mechanism is not clear; nor is it clear that the over-expansion in this industry would have been nearly so serious had not the depression mainly had its roots in financial or other sectors of the economy independent of the firms in this industry.

Also, the inference is that once firms have experienced several successful years, they are not likely to predict an unsuccessful one for their business during the next one, at least in terms of their plans and actions. Verbalizations may lead one to believe that a poor year is predicted, but in practice (according to the interviews with executives in the rubber industry) "tomorrow" is almost always assumed to be "today's" equal.

This is not to say, of course, that the firms do not move without contemplating the possibility of the most serious problems. They almost always make provisions for disaster (by insurance, liquidity, bank loans agreed upon in advance, flexible contracts or contracts calling for installment buy-
ing of equipment with a cancellation option) and they are relatively quick to act upon adverse signals. Generally, there is no hesitation in abandoning projects irrespective of financial resources already invested in them, if storm warnings appear either for the business as a whole or for that particular project. For some projects, of course, unfavorable profit and loss statements may be predicted for several fiscal periods in order that new products can be developed or new techniques tried out. However, if predictions go far wrong, the firm will not hesitate to retrench.

The signals for such trouble are not esoteric or complex. In the earlier days of the rubber industry, for example, they were exceedingly simple and understandable: The firm was "not selling tires."

Generally, there are requests within the firm for more capital expansion funds than the firm has available. While there are exceptions, this study indicates that there is no paucity of ideas for development within the firm. It is more often the financial considerations, and the swings of the economy, that dampen expansion plans. From a theoretical point of view, this means that "autonomous" investment seems clearly to be a part of the firm's planning, and that projects are constantly on file and requested several times before final approval.
It is difficult to say what the limits are on this autonomous investment, but representatives of the rubber industry indicated that a prime operational test is whether there is a market or indication of a market. While this may seem to be a trivial observation, its implication is that expectations refer to a tangible set of relationships, namely market research estimates compared with cost predictions. However, cost-price theories of the business cycle receive little support from this study. While there was some indication that projects are postponed due to high costs, it did not seem to be the case that the total expansion program was cut back due to rising labor, material, and equipment costs.

If possible, these investments are made with a view to expanding them as demand considerations permit. That is, if a new plant is built, more real estate will be purchased than is necessary at the time, a bigger power plant may be built than is currently needed, and so on.

There seemed to be clear-cut evidence that "induced" investment is important to individual firms. The method of making these induced investment expenditures is significant. Consistent with the analysis of P.W.S. Andrews, firms try first to meet a "hump" in sales by increasing hours of work, extra shifts, overtime, and so on. New machines may be added to existing plant and equipment. The most common situation, to which much of the
trade journal material in Chapter VI is pointed, depicts plant expansion when a firm is operating 24-hours a day, seven days a week, with back-logs of orders and sales twice those of the previous year. The importance of recent sales, back-logs of orders (particularly the relationship between plant capacity and ability to keep up with sales) and rush jobs cannot be over-emphasized. The foregoing process is somewhat obscured today because diversification of production and the institutionalization of the entrepreneur have created so many directions of development and lines of authority. However, this basic scheme of expansion is still valid despite these complicating factors.

As was pointed out earlier, firms are quick to retrench if the situation turns against them. The signals are easily read, and the firms tend to "follow the state of trade" rather than to lead it. This points up the difference between the professional entrepreneur in the manufacturing sector of the economy and the finance capitalism typical of other sectors. Manufacturing concerns, of course, have to play by the rules of the finance game, once "the chairs are removed". But they do not seem to have the "musical chairs" attitude described by Lord Keynes.
F. Plan of Thesis

In this study an attempt is made to demonstrate that when entrepreneurs face situations capable of divergent interpretations, a "subjective structuring process" enables them to explain these situations in terms of a limited number of variables. An attempt will also be made to show how it is possible to draw from observations of consistencies in investor behavior, inferences about this structuring process.

The general plan from this point is first to review literature on economic behavior under conditions of uncertainty. Mainly theoretical and model building efforts will be surveyed in Chapter 2 while empirical work will be summarized in Chapter 3. Chapter 4 will be devoted to a selective history of the rubber industry with particular attention to plant expansion. A factor analysis of certain data pertaining to one of the rubber firms will be performed in Chapter 5. Narrative sources, mainly trade journals, will be examined next for further explanation of the origin, change, realization or non-realization of expectations. Summaries of interviews with several executives in the Akron area will conclude the study, except for a summary of procedure and conclusions in the last chapter.
These conclusions are substantiated by a study of the rubber industry, its history, and trade journal accounts of plant expansion. A minor statistical study consisting of a factor analysis of several variables related to the Goodyear Tire and Rubber Company also supports these conclusions. There, two factors depicting "autonomous" and "induced" investment seemed to be clearly evident.

Interviews with executives in several rubber manufacturing firms also substantiated these views. The main impression derived from these interviews was that autonomous and induced investment are valuable constructs for the analysis of investment decisions.

Most executives clearly outlined the situation where firms were operating with full capacity at every available minute, and unable to fill back-logs of orders, felt themselves forced to expand. While the concept of induced investment is not very useful to the individual firm in its planning in these cases, it is clearly depicted for theoretical purposes. The operation of induced investment through time seems likely to be best represented by an exponential curve. Investment expenditures in response to increased demand will not be very heavy since firms will endeavor to meet the increased sales by extra hours, extra shifts and so on. The process will be cumulative, however, and firms will make every effort not to lose their
share of the market in an expanding market or the introduction of a new product.

Likewise executives were unanimous in their emphasis on the importance to a firm of giving attention to new products, new techniques, secular demand, population changes — that is, to autonomous investment. These areas of investment seem to be constantly under consideration when executives consider the disposition the firm wishes to make of its available funds.

Some of the conclusions which might be drawn from this study are as follows:

First, with respect to "differences in perception" of investment opportunities from one firm to another, the conclusion is that they are not substantial. The signals to which firms respond are related too closely to sales opportunities to make much difference of attitude possible on this score. (Whether there are "subtle" differences in the perception of these opportunities not discovered in this study is a topic perhaps for further research). Further, since the rubber products industry is one of the most competitive in terms of product policy (innovations), price and selling costs and so on, the conclusion seems generally valid that manufacturing firms must make their investment expenditures coincidently with others or they will lose their "share of the market".
Thus, according to this study, the effect of the accelerator along does not seem likely to induce the wide fluctuations in output which have actually occurred in the past. Financial collapse must account for the severity of depression. If the business cycle turned on the decisions of these "professional entrepreneurs", it would not be as severe or as abrupt. The sum of the decisions of all firms, sometimes conflicting, of course, would lead to oscillations, but not likely to anything of the magnitude of 1929.

Second, with respect to the role of profits vis-à-vis the accelerator, this study shows that profits provide the available funds which are the enabling factors. Profits are not the signal for plant expansion but enable a firm to make the expansion. Sales possibilities and the relation of sales to capacity are the most important considerations. The role of inventories seems currently to be a more passive one, at least in the rubber industry, than formerly. Prior to the development of synthetic capacity, the survival of firms depended as much on their ability to handle crude rubber inventories as on their production, sales, or pricing procedures. This seems never to have initiated a decline in the rubber industry, however; the main effect having been to make depression a more serious problem for firms holding high priced inventories.
Third, while this conclusion can be carried to an undue extreme, it is fair to say that this study shows considerable justification for internal financing from two points of view. First, investment expenditures are likely to be more stable when firms do not have to use "external" financing to which they generally have an aversion. Second, the development of new products seems to be more likely when firms are able to "carry" losing projects for a period of time until they begin to be profitable. The present study was not concerned primarily with this question, but it is an impressionistic conclusion which seems worth recording. In a sense, it is at this point that whatever link is possible between micro- and macro-economics probably exists. While firms "partially elude" the market place in making these decisions on new products, they cannot elude it for long, and the rate of interest no longer seems to be very important to them in their investment decisions, partly because of their size.

Fourth, as was pointed out above, the concepts of "induced" investment and "autonomous" investment, as outlined in Hicks receive considerable empirical support. While the empirical referent of "autonomous" is not as clear as that of "induced", both terms have operational significance for the theory of the firm.
In a certain sense, according to this study, "expectation" (waves of optimism and so on) in the manufacturing sector do not have the importance which has so often been ascribed to them. However, observations over a considerable time period would be required to substantiate this conclusion.

This study has obviously not produced the "maximum maximum" of information or conclusions. There are some areas for further research. A few of these may now be indicated.

From the clinical point of view, there is a problem that relates to motivation which is incapable of direct verbalization on the part of the actor. The difference between "rationalization" and explanation is difficult to characterize. Consequently, it is difficult to say how much of the trade journal material and executive remarks was explanation and how much "rationalization." Additional analysis of a subtle kind would be helpful on this point.

Further, the writer was not able to design or administer tests to exhibit the relationship between dispersion of expectations, probabilities with which these expectations are held, and consequent action. Several theoretical constructs of this nature were not adequately tested. More rigorous, and more sharply delimited, studies of this nature might be helpful.

Any continuation of this kind of research should aim at a greater degree of quantification than achieved in this study.
For instance, in the interviews with executives, the questionnaire method might have yielded more clear-cut factors. Obviously, the size of the sample of executives should have been larger, and the study conducted over a longer span of time. Such studies should be made through time, with recurrent interviews and continuous data on sales, inventories, back-orders, cash and so on. These could be cross-referenced against actual plant expansion. Thus answers might be given to questions relating to the amount by which expectations must be wrong before there is revision of plans.

Industry representatives, however, are not able to grant access to all the information which a researcher would want nor to answer all the questions he would like to raise. The writer was not able to examine, for example, executive authorizations for capital expenditures. These papers contain written memoranda of the reasons for plant expansion, both as to direction and timing. However, the writer's experience was that the executives interviewed were co-operative and understanding, and that research over a considerable period of time might yield valuable information. Examination of records not too closely related to the firms' current operations might perhaps be examined in the future. Certainly there is much more to be learned.
APPENDICES
"Linear programming" is a recent theoretical development concerned with entrepreneurial choice as it relates to alternative technologies open to the firm. Linear programming theory views entrepreneurial decisions as the selection of proper "levels of a set of processes." A process is defined in linear programming as encompassing productive events which use "the same resources in the same proportions" in the production of the same "outputs in the same proportions."

This proportionality is the origin of the term linear, in the title linear programming. Programming, of course, relates to scheduling of activities within some closed unit.

Any level may be selected as the unit level of a process and thus becomes a metric for specifying the intensity of use of a process. Usually the ratio of inputs producing $1 revenue is considered to be the basic unit.

Linear programming then studies "the consequences of using several processes in parallel." The usual production function


2 If $a_{ij}$ is the amount of the first factor used in the $i$th process, and $a_{ij}$ the amount of the first factor used in the $j$th process, and $b_{i1}$ and $b_{j1}$ are the corresponding outputs, then two processes are identical if: $a_{i1}/a_{j1} = a_{i2}/a_{j2} = \ldots = b_{i1}/b_{j1} = b_{i2}/b_{j2} = \ldots = a_{in}/a_{jn} = b_{i1}/b_{j1}$. 
does not present this parallel use of combinations of resources (this parallel use being brought about in practice by the finite nature of at least some of the resources available to the firm).

Let $E_j$ be a process with inputs and outputs as follows:

$$E_j = (\alpha_1, \alpha_2, \ldots, \alpha_j, \alpha_{j+1}, \ldots, \alpha_k) = P_j$$

Let $X = (x_1, x_2, \ldots, x_k)$ be the levels at which the processes are used.

A production program, $T$, then is

$$T = (x_1P_1, x_2P_2, \ldots, x_kP_k)$$

Then if $A = (a_{11}, a_{12}, \ldots, a_{ik})$ and $X$ be the vector of process intensities, total consumption of factors is the product of $AX = Z$.

The relationships between the use of factors in different processes is thus easily stated in matrix form. Total consumption of factors is equal to the processes times the intensity of use of the process. Total output is represented in analogous fashion.

The problem of linear programming is to specify the optimum

\[ a_{11}x_1 + a_{12}x_2 + \cdots + a_{1k}x_k = Z_1 \\
\vdots \\
Q_{1m}x_1 + a_{21}x_2 + \cdots + a_{2k}x_k = Z_m \]
intensity vectors. It turns out that if there are n factors in limited supply that the optimum process intensity vector will have n positive terms. This is a basic solution.\(^4\)

The numerical intensities assigned to each process are determined by an iterative process, after disposal processes and a revenue column vector have been added to the production matrix. A disposal process is assumed to be such that the excess of any factor in fixed supply for the firm can go costlessly (for the firm) to waste.

The iterative process of finding the optimum process intensity vector usually starts with one active and n-1 disposal processes. The intensities assigned to these processes are limited by the requirement that they be a linear combination, this constraint serving as a formula for writing down the first trial intensities. Revenue from "excluded processes" then is compared with an "equivalent combination" of included processes until no excluded process is more profitable than its "equivalent combination" of included processes. This test is called a "simplex criterion."\(^5\)

Linear programming theory is as yet inadequate as a theory of responses to uncertainty. It requires knowledge of revenue

\(^4\) This is one part of an optimum program. The other consideration in such a program is that it meet the "simplex criterion" which is merely a standard for maximization.

Chapter II

THEORETICAL APPROACHES AND MODEL BUILDING

A. Purpose

The purpose of this and the following chapter is to give a summary of the literature on the economics of uncertainty. The approach of the neo-classical school is examined. Other mainly theoretical contributions follow in approximately chronological order.

Chapter Three extends the theory developed in Chapter Two and devotes considerable attention to empirical and institutional evidence.

B. Neo-Classical Approach

The organizational principle of the classical approach has an implicit ecological orientation. Ecological relationships refer to interdependence within a population in a given environment, and to adjustment required of individual units when any one of them, or the environment, undergoes change. General equilibrium theory is the analogical equivalent of the ecological problem in biology. Theories of control mechanisms (with applications in biology and electronics) are analogous to particular equilibrium analysis and the theory of the firm. Recent developments in control
functions which firms do not have in the nature of the un-
certainty situation (that is, where the uncertainty situation
is defined as ignorance of parameters of probability distribu-
tions of future events). Dorfman notes that by "assuming
that the relevant market and technological functions are
known, the sort of models considered (in linear programming)
evade the most critical problems which confront the
entrepreneur." He expects stochastic models to become
actualities within a few years. However, linear programming
(like its near-relative and progenitor, input-output analysis)
is not yet capable of dealing with the problems of uncertainty.

6 Dorfman, op. cit., p 90.
Appendix B - Chapter II

C. F. ROOS

Let \( y \) equal demand and

\[
y = \sum_{i} u_i = g(u_1, u_1', u_2', \ldots u_n', p, p', t)
\]

where \( u_i \) is the quantity supplied by the \( i \)th producer, \( p \) equals price, \( p' \) the first derivative of price, \( t \) equals time.

Transposing \( g(\ ) \) one obtains

\[
G(u_1, u_1', \ldots u_n, u_n', p, p', t) = 0
\]

The net profit of a producer over time is

\[
\mathcal{C}_k = \int_{t_0}^{t_1} (p u_k - \phi_k) dt \quad \text{where } \phi_k \text{ is a function representing total cost of manufacturing and distributing per unit of time. Now, } \phi_k \text{ will "certainly be a function of the rate of production and may depend on other factors as well." For example, it is a function of price. Again the cost of production will be influenced by the acceleration of production and hence depends upon } u'(u'' \text{ also, if acceleration}).
\]

To insure generality write

\[
\phi_k = \phi(u, u', u_1'', \ldots u_n, u_n'', p, p', t)
\]

The integrand of \( \mathcal{C}_k \) becomes \( p u_k - \phi_k \) which Roos calls \( F_k \). Given the end times \( t_0 \) and \( t_1 \), and the end value of the prices and rates of production fixed at \( t_0 \), choose \( t \) the theoretical price, \( p \), and the rates of production defining
the curve in the space $u_1, u_2 \ldots u_n, p, t$, such that it satisfies an equation of the type $G(u_1, u_1', \ldots u_n, u_n', p, p', t) = 0$, where $\Pi_k$, the profit, is a maximum.

Roos shows that this conceptually possible with the use of Lagrange Multipliers and suggests application to empirically derived curves. Roos himself does not show in this article the form of his dynamic demand equation in terms of statistical data.
Appendix C - Chapter II
RGD ALLEN, PATH ANALYSIS

Write
\[ x = \emptyset \{ p(t), p'(t) \} \quad \text{for dynamic demand function} \]
\[ x = f \{ p(t), p'(t) \} \quad \text{for dynamic supply function} \]

For equilibrium \( \emptyset = f \)
\[ \emptyset \{ p(t), p'(t) \} = f \{ p(t), p'(t) \} \] which is a differential equation, the integral of which yields \( p \) a function of \( t \), plus one arbitrary constant.

This constant can be determined, given the boundary condition \( p_0 \) at time \( t_0 \). Given the initial, price, the course of prices over time is determined.

As an illustration, Allen considers the case where demand and supply functions are linear. Under static conditions,
\[ x = ap + b \quad \text{demand} \]
\[ x = \alpha p + \beta \quad \text{supply} \]
where \( a \) and \( \beta \) are negative and \( b \) and \( \alpha \) are positive.

For equilibrium
\[ ap + b = \alpha p + \beta \]
and the equilibrium price \( \bar{p} = \frac{\alpha - a}{\beta - \alpha} \)

In the simple speculative case
\[ \text{demand} \quad x = ap(t) + b + c \quad p'(t) \]
\[ \text{supply} \quad x = \alpha p(t) + \beta + \gamma p'(t) \]

Here let \( c \) and \( \gamma \) be positive, implying that a rising price
stimulates both demand and production. (\( V \) could be negative if sellers withhold supplies for higher prices later.)

For a "moving equilibrium"

\[
ap(t) + b + cp'(t) = \alpha p(t) + \beta + \nu p'(t)
\]

or \( p'(t) = \frac{\alpha - a}{c - \nu} \left\{ p(t) - \bar{p} \right\} \)

where \( \bar{p} = \frac{b - \beta}{\alpha - a} \)

Write \( q(t) = p(t) - \bar{p} \)

Then let \( \lambda = \frac{\alpha - a}{c - \nu} \)

\( p'(t) = \lambda \left\{ p(t) - \bar{p} \right\} \) and \( q(t) = \left\{ p(t) - \bar{p} \right\} = \frac{p'(t)}{\lambda} \)

\( q'(t) = p'(t) = \lambda q(t) \) or \( \frac{1}{q} \frac{dq}{dt} = \lambda \)

The integral of this differential equation is:

\[
q = Ac^t
\]

then \( p(t) = \bar{p} + Ae^{\lambda t} \)

Determining \( A \) at boundary, \( t = 0 \) \( p = 0 \), the initial price,

\( A = p_0 - \bar{p} \)

Thus \( p(t) = \bar{p} + (p_0 - \bar{p})e^{\lambda t} \)

where \( \bar{p} = \frac{b - \beta}{\alpha - a} \)

and \( \lambda = \frac{\alpha - a}{c - \nu} \)

It can readily be seen that depending upon the sign of \((c - \nu)\), price will either diverge from the equilibrium price or converge toward it. Precisely, must be positive to insure a stable course of prices. "Speculative" element in supply must be stronger than "speculative" element in demand for a price approaching equilibrium.
Allen does not consider the question of determining empirical values for $c$ and $\sqrt{\nu}$ or any of the other parameters. His analysis, however, is an example of the way in which one may decide which parameters need to be given factual content.
Appendix D – Chapter II

G. L. S. SHACKLE

Shackle builds up his theoretical analysis as follows.

Write \( \phi = \phi(x, y) \) for the intensity of any (say, an investment) experience due to its anticipation. Since \( y = y(x) \), \( \phi = \phi(x, y(x)) \).

Suppose some value of \( x \), say \( x = 0 \), causes neither distress nor enjoyment. Between \( x = 0 \) and the upper extreme of the inner range, \( \frac{d\phi}{dx} = 0 \) and \( \frac{\partial \phi}{\partial y} \frac{dy}{dx} = 0 \) while \( \frac{\partial \phi}{\partial x} > 0 \).

Over this interval \( \phi \) is an increasing function of \( x \). Beyond the upper extreme of the inner range \( \frac{d\phi}{dx} > 0 \) and therefore since \( \frac{\partial \phi}{\partial y} \) is everywhere negative, \( \frac{\partial \phi}{\partial y} \frac{dy}{dx} \) is here negative while \( \frac{\partial \phi}{\partial x} \) is, of course, still positive.

Then "for values of \( x \) which the individual regards as impossible, \( \phi = 0 \)." In most cases there will occur finite values for \( x \) having such nil enjoyment.

Thus, somewhere between the least of the \( x \) values considered impossible and the \( x \) associated with the upper limit of the inner range, we set the first derivative (with respect to \( x \)) of \( \phi \) equal to zero.

Here \( \phi \) is a maximum. Let \( z = f(x) \) and find \( \phi \) with respect to \( z \). These two values Shackle labels primary focus gain.
and primary focus loss. Call $\phi$ the stimulation function.

In three dimensions $\phi$ resembles a mountain valley the contour lines of which are representatives of different and increasing levels of enjoyment as $x$ changes. They are the contour lines projected onto the $xy$-plane by $\phi = \text{some constant}$. The valley has a broad mouth running along $y = -y$, and tapers down to the point $x = 0, y = 0$. "Rising on either side from the floor of the valley are the two sheets of the sloping $\phi$ surface."

The potential surprise curve drawn over these contour lines will be tangent to one of them on either side of the valley. The contour line with which $y(x)$ is tangent is the highest such line it crosses. Following the contour line down to the $x$-axis yields a standardized focus outcome.
Appendix — Chapter III

INTER-FIRM PLANS AND EXPECTATIONS

Inter-firm plans have particular significance with reference to the business cycle. Marshall, Angell, Hart and others have noted this.¹ For example, Hart says, "In looking at estimates of the future, it is important not only in which direction opinion expects affairs to go, but also how closely people agree and how confident they are of their estimates."² General opinion of what is "normal" is important. If people think post-war prices are "abnormally" high, a trend downward is likely, according to Hart.

Katona in this connection refers to Hicks' distinction between elastic and inelastic expectations. Elasticity of

¹ Marshall, Alfred, Money, Credit and Commerce, London: Macmillan Company, 1923, pp 249-51. "Credit is ever more confident; bankers and others lend more freely; the instruments of credit multiply; prices, wages, and profits go on rising; there is a general rise in the incomes of those engaged in trade; they spend freely, increase the demand for goods and raise prices still higher. Many speculators seeing the rise, and thinking it will continue, buy goods with the expectation of selling them at a profit. At such a time a man who has only a few hundred pounds can often borrow from bankers and others the means of buying many thousand pounds worth of goods; and everyone who thus enters into the market as a buyer, adds to the upward tendency of prices, whether he buys with his own or borrowed money. The crisis comes when those whose business it is to lend money become distrustful, become eager to secure themselves and refuse to renew their loans on easy, or even on any terms."

price expectations is greater than one "when a change in
current price causes people to recognize a trend," that is,
expect future price changes to be larger percentagewise
than the current changes. Hicks concludes, on the basis
of certain restrictive assumptions, that systems with
highly elastic price expectations are unstable. This may
seem intuitively obvious. However, Katona argues that
expectations concerning future trends of prices are
crucial in inflation situations. It makes a difference
for the whole economy whether people expect "cumulative
processes" or "non-cumulative processes." Studies of
these trends on a national scale turn on our ability to
describe, measure and predict individual expectations.

Shackle relates changes in average expectations and
total income somewhat as follows. Expectations depend upon
rate of change of income. A constant rate of change of in­
come is quickly adjusted to by firms and individuals. Any
increase in income due say to a multiplier mechanism is
unexpected by individual entrepreneurs and this further
increases expectations and likewise net investment. As
investment adjusts to this incremental figure, total income

3 Katona, George, Economic Analysis of Economic Behavior, p 270.
4 Ibid., p 264.
theory have emphasized the concept of homeostasis. In a homeostatic control mechanism an error in the output of a system is fed back into the input as a correction, thus bringing the system back into equilibrium. Marginal analysis is a special case of the theory of homeostatic mechanisms.¹

The general equilibrium school phrased their statement of the interdependence of economic units as follows:

\begin{align}
 f_1(x_1, x_2, \ldots, x_n, \alpha_1, \alpha_2, \ldots, \alpha_m) &= 0 \\
 f_2(x_1, x_2, \ldots, x_n, \alpha_1, \alpha_2, \ldots, \alpha_m) &= 0 \\
 \vdots \quad \vdots \quad \vdots \quad \vdots \\
 f_n(x_1, x_2, \ldots, x_n, \alpha_1, \alpha_2, \ldots, \alpha_m) &= 0 \\
\end{align}

(2.1)

where there are n variables and m parameters.² Particular equilibrium under competition is merely a special case of general equilibrium.³

Profit and loss data are the "output" of the system to which individual firms respond. Under the assumptions of

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¹ Cf. Boulding, Kenneth, Abstract of a discussion "The Impact on General Economics of More Realistic Theories of the Firm," Econometrica, Vol. 20, No. 3, July, 1952, pp 483-4. Boulding has recently introduced into his theoretical work some of the terms used by biologists. This is at least the third such attempt in fairly recent history. Herbert Spencer is today generally considered to have been too extreme and the Chicago school of social ecologists was not completely successful. See also Boulding's Reconstruction of Economics, New York: John Wiley and Sons, 1950.


³ Ibid., p. 27. "Particular equilibrium consists of nothing more than a liberal sprinkling of zeros into the equations of general equilibrium."
likewise increases. Entrepreneurs then begin to expect this increase, but when they learn to foresee such increases, these are no longer unexpected events acting to push investment up. Thus investment levels off and the rate of change of income declines, reversing the expectational process.\(^5\)

Angell has a similar analysis. The key factor is the unexpected nature of income increases, these increases generating endogenously a business cycle. Anticipations become the trigger mechanism for the business cycle inevitably accompanying an individualistic economy, according to Angell. The hypothesis around which Angell's analysis is built is that "anticipations depend on the rate of change in previous income."\(^6\) More exactly, they depend on "the relation between its (income) rates of change at a number of different previous times."\(^7\)

Shackle also argues that short-period anticipations are governed by the recent history of national money income. This is true, he says, not because the investor "looks consciously at his own or national money income." Rather it is because the entrepreneur looks at estimated future

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6 Angell, James, *Investment and Business Cycles*, p 76.
7 Ibid., p 76.
receipts of his business. Since national money income moves closely with business receipts an investigator may conveniently take this as a measure of business receipts. Therefore, short-term changes in anticipations "are primarily governed by the recent history of the national money income" particularly in the preceding few months.

Changes in income, however, stem from previous changes in anticipations, in Shackle's analysis. What are the proper connecting links?

Angell attempts to answer this question. Angell assumes that a change in anticipations will produce a proportional change in income "fairly promptly." On the other hand, a change in income may for a time exert a proportional change in anticipations but as net investment becomes consistent with the rate of increase of national income, anticipations can remain constant.

What Angell hypothesizes is that anticipations rise slightly before the lower turning point of the cycle; they accompany investment and income upwards, decreasing when

8 Shackle, op. cit., p 72. Note in Chapter III the study by Dice and Eiteman showing that business payments are largely a response to anticipated receipts.

9 Friend and Bronfenbrenner, "Business Investment Programs and Their Realization," found that an important factor in non-realization of investment plans related to estimates of earnings.

10 Shackle, op. cit., although the relationship is not as clearly defined there. This does not take account of the "flurry" of investment activity which often occurs near the peak of the cycle, as is pointed out in Chapter V.
the rate of change of investment drops. Graphically this is shown as follows.\textsuperscript{11}

Figure 3.1

\begin{center}
\begin{tikzpicture}
\draw[->] (-2.5,0) -- (2.5,0) node[right] {$dI/dT$};
\draw[->] (0,-2) -- (0,2) node[above] {Anticipations};
\end{tikzpicture}
\end{center}

Expansion of investment will not increase indefinitely due to 1) unfavorable cost-price ratios 2) "saturation" in particular fields and 3) propensity to save of upper income groups. Further, an upturn in anticipations occurs because of the need for repairs and replacements, low inventories, accumulation of opportunities for technical improvements.

This is similar to the cycle outlined by Hicks more recently although it is not as rigorous an analysis and does not recognize the important role played by firms' inability to disinvest quickly in capital equipment.

The main hypothesis which should be noted here is the temporal relation between national money income and anticipations, namely a lag of three to six months.

\textsuperscript{11} Angell, \textit{op. cit.}, p 83.
Appendix - Chapter V

Table 5.3

Plant Expansion in the Goodyear Tire and Rubber Company, 1915-1950

(Increase in fixed assets, year \((n-1)\) to year \(n\))

<table>
<thead>
<tr>
<th>Variable 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year</td>
</tr>
<tr>
<td>1950</td>
</tr>
<tr>
<td>1949</td>
</tr>
<tr>
<td>1948</td>
</tr>
<tr>
<td>1947</td>
</tr>
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<td>1945</td>
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<tr>
<td>1944</td>
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<tr>
<td>1943</td>
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<tr>
<td>1942*</td>
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<tr>
<td>1941</td>
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<tr>
<td>1940</td>
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<td>1939</td>
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<td>1936</td>
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<tr>
<td>1935</td>
</tr>
<tr>
<td>1934</td>
</tr>
<tr>
<td>1933</td>
</tr>
</tbody>
</table>

* For 1942, due to loss of Far Eastern investments, disinvestment occurred in the amount of $11,075,855. This accounting transaction is omitted here.

Table 5.4

Net Sales of the Goodyear Tire and Rubber Company,
1915-1950

Variable 2

<table>
<thead>
<tr>
<th>Year</th>
<th>Sales</th>
<th>Year</th>
<th>Sales</th>
</tr>
</thead>
<tbody>
<tr>
<td>1915</td>
<td>$102,901,177</td>
<td>1916</td>
<td>$59,122,281</td>
</tr>
<tr>
<td>1916</td>
<td>136,300,761</td>
<td>1917</td>
<td>103,558,669</td>
</tr>
<tr>
<td>1917</td>
<td>122,675,726</td>
<td>1918</td>
<td>122,675,726</td>
</tr>
<tr>
<td>1918</td>
<td>158,258,892</td>
<td>1919</td>
<td>122,675,726</td>
</tr>
<tr>
<td>1919</td>
<td>188,866,024</td>
<td>1920</td>
<td>122,675,726</td>
</tr>
<tr>
<td>1920</td>
<td>185,915,675</td>
<td>1921</td>
<td>122,675,726</td>
</tr>
<tr>
<td>1921</td>
<td>165,928,914</td>
<td>1922</td>
<td>102,901,177</td>
</tr>
<tr>
<td>1922</td>
<td>217,540,079</td>
<td>1923</td>
<td>127,880,083</td>
</tr>
<tr>
<td>1923</td>
<td>330,559,674</td>
<td>1924</td>
<td>138,777,719</td>
</tr>
<tr>
<td>1924</td>
<td>451,93,031</td>
<td>1925</td>
<td>205,999,829</td>
</tr>
<tr>
<td>1925</td>
<td>760,141,044</td>
<td>1926</td>
<td>230,161,356</td>
</tr>
<tr>
<td>1926</td>
<td>786,722,287</td>
<td>1927</td>
<td>222,178,540</td>
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<tr>
<td>1927</td>
<td>716,176,749</td>
<td>1928</td>
<td>250,769,209</td>
</tr>
<tr>
<td>1928</td>
<td>670,772,647</td>
<td>1929</td>
<td>256,227,067</td>
</tr>
<tr>
<td>1929</td>
<td>633,505,978</td>
<td>1930</td>
<td>204,063,229</td>
</tr>
<tr>
<td>1930</td>
<td>704,875,941</td>
<td>1931</td>
<td>159,199,831</td>
</tr>
<tr>
<td>1931</td>
<td>$109,051,758</td>
<td>1932</td>
<td>$109,051,758</td>
</tr>
<tr>
<td>1932</td>
<td>814,138,051</td>
<td>1933</td>
<td>109,051,758</td>
</tr>
</tbody>
</table>

* Ten months in 1921, after reorganization.

Table 5.5.
Inventories in the Goodyear Tire and Rubber Company
Balance Sheet, 1915-50

<table>
<thead>
<tr>
<th>Year</th>
<th>Inventory</th>
<th>Year</th>
<th>Inventory</th>
</tr>
</thead>
<tbody>
<tr>
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<td>$168,393,840</td>
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<td>$35,666,253</td>
</tr>
<tr>
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<td>1931</td>
<td>45,190,308</td>
</tr>
<tr>
<td>1948</td>
<td>163,772,003</td>
<td>1930</td>
<td>57,006,290</td>
</tr>
<tr>
<td>1947</td>
<td>149,332,704</td>
<td>1929</td>
<td>66,111,896</td>
</tr>
<tr>
<td>1946</td>
<td>101,681,827</td>
<td>1928</td>
<td>68,736,251</td>
</tr>
<tr>
<td>1945</td>
<td>83,115,125</td>
<td>1927</td>
<td>68,753,686</td>
</tr>
<tr>
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<td>1926</td>
<td>67,915,300</td>
</tr>
<tr>
<td>1943</td>
<td>95,942,903</td>
<td>1925</td>
<td>38,058,123</td>
</tr>
<tr>
<td>1942</td>
<td>94,191,967</td>
<td>1924</td>
<td>31,051,512</td>
</tr>
<tr>
<td>1941</td>
<td>83,009,592</td>
<td>1923</td>
<td>37,003,779</td>
</tr>
<tr>
<td>1940</td>
<td>71,203,869</td>
<td>1922</td>
<td>30,585,736</td>
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<tr>
<td>1939</td>
<td>53,267,037</td>
<td>1921</td>
<td>32,232,778</td>
</tr>
<tr>
<td>1938</td>
<td>61,000,321</td>
<td>1920</td>
<td>41,167,758</td>
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<tr>
<td>1937</td>
<td>73,987,017</td>
<td>1919</td>
<td>35,566,779</td>
</tr>
<tr>
<td>1936</td>
<td>75,693,446</td>
<td>1918</td>
<td>30,507,967</td>
</tr>
<tr>
<td>1935</td>
<td>58,902,758</td>
<td>1917</td>
<td>28,495,624</td>
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<tr>
<td>1934</td>
<td>55,754,471</td>
<td>1916</td>
<td>16,913,077</td>
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<tr>
<td>1933</td>
<td>39,422,407</td>
<td>1915</td>
<td>7,763,189</td>
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</table>

### Table 5.6

Cash and Bank Deposits of the Goodyear Tire and Rubber Company, 1915 - 1950

*Variable 4*

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<th>Year</th>
<th>Cash</th>
<th>Year</th>
<th>Cash</th>
</tr>
</thead>
<tbody>
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<td>$51,031,990</td>
<td>1932</td>
<td>$24,981,716</td>
</tr>
<tr>
<td>1949</td>
<td>34,222,579</td>
<td>1931</td>
<td>21,455,899</td>
</tr>
<tr>
<td>1948</td>
<td>30,758,646</td>
<td>1930</td>
<td>29,397,252</td>
</tr>
<tr>
<td>1947</td>
<td>63,411,050</td>
<td>1929</td>
<td>15,873,582</td>
</tr>
<tr>
<td>1946</td>
<td>50,792,703</td>
<td>1928</td>
<td>11,567,224</td>
</tr>
<tr>
<td>1945</td>
<td>44,925,568</td>
<td>1927</td>
<td>10,069,348</td>
</tr>
<tr>
<td>1944</td>
<td>16,962,568</td>
<td>1926</td>
<td>9,584,363</td>
</tr>
<tr>
<td>1943</td>
<td>27,336,297</td>
<td>1925</td>
<td>15,750,060</td>
</tr>
<tr>
<td>1942</td>
<td>24,123,082</td>
<td>1924</td>
<td>11,494,120</td>
</tr>
<tr>
<td>1941</td>
<td>13,489,563</td>
<td>1923</td>
<td>13,204,649</td>
</tr>
<tr>
<td>1940</td>
<td>19,952,758</td>
<td>1922</td>
<td>10,334,180</td>
</tr>
<tr>
<td>1939</td>
<td>25,627,375</td>
<td>1921</td>
<td>14,423,640</td>
</tr>
<tr>
<td>1938</td>
<td>16,486,740</td>
<td>1920</td>
<td>1,667,373</td>
</tr>
<tr>
<td>1937</td>
<td>11,071,248</td>
<td>1919</td>
<td>10,395,241</td>
</tr>
<tr>
<td>1936</td>
<td>13,078,143</td>
<td>1918</td>
<td>6,344,490</td>
</tr>
<tr>
<td>1935</td>
<td>24,136,988</td>
<td>1917</td>
<td>3,783,354</td>
</tr>
<tr>
<td>1934</td>
<td>19,032,832</td>
<td>1916</td>
<td>10,013,971</td>
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<tr>
<td>1933</td>
<td>18,951,898</td>
<td>1915</td>
<td>7,851,331</td>
</tr>
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*Source: Moody's Investment Manual, 1915-1950*
Table 5.7
Notes and Accounts Receivable of Goodyear Tire and Rubber Company, 1915-1950

Variable 5

<table>
<thead>
<tr>
<th>Year</th>
<th>Accounts Receivable</th>
<th>Year</th>
<th>Accounts Receivable</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950</td>
<td>$109,958,207</td>
<td>1932</td>
<td>12,479,905</td>
</tr>
<tr>
<td>1949</td>
<td>65,861,734</td>
<td>1931</td>
<td>16,151,401</td>
</tr>
<tr>
<td>1948</td>
<td>60,612,940</td>
<td>1930</td>
<td>22,184,736</td>
</tr>
<tr>
<td>1947</td>
<td>63,713,176</td>
<td>1929</td>
<td>28,717,143</td>
</tr>
<tr>
<td>1946*</td>
<td>70,713,113</td>
<td>1928</td>
<td>22,129,114</td>
</tr>
<tr>
<td>1945*</td>
<td>50,232,956</td>
<td>1927</td>
<td>17,891,188</td>
</tr>
<tr>
<td>1944</td>
<td>71,948,776</td>
<td>1926</td>
<td>15,615,823</td>
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<tr>
<td>1943</td>
<td>70,682,558</td>
<td>1925</td>
<td>14,482,789</td>
</tr>
<tr>
<td>1942</td>
<td>64,604,427</td>
<td>1924</td>
<td>9,966,711</td>
</tr>
<tr>
<td>1941</td>
<td>13,700,761</td>
<td>1923</td>
<td>11,300,000 estimate</td>
</tr>
<tr>
<td>1940</td>
<td>25,980,561</td>
<td>1922</td>
<td>12,062,903</td>
</tr>
<tr>
<td>1939</td>
<td>28,850,116</td>
<td>1921</td>
<td>10,194,500</td>
</tr>
<tr>
<td>1938</td>
<td>27,262,373</td>
<td>1920**</td>
<td>12,201,181</td>
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<tr>
<td>1937</td>
<td>23,036,010</td>
<td>1919</td>
<td>27,052,804</td>
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<td>23,912,044</td>
<td>1918</td>
<td>13,355,985</td>
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<tr>
<td>1935</td>
<td>21,618,481</td>
<td>1917</td>
<td>16,384,333</td>
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<tr>
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<td>17,961,817</td>
<td>1916</td>
<td>10,013,971</td>
</tr>
<tr>
<td>1933</td>
<td>14,999,056</td>
<td>1915</td>
<td>9,000,000 estimate</td>
</tr>
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</table>

* Includes termination war contracts claims receivables, 1946 - $174,138; 1945, - $14,267,254.

** Does not include $3,568,445 due from F. A. Seiberling.

Table 5.8

Disposal Income in the United States

1915-1950

(In Billions of Dollars)

<table>
<thead>
<tr>
<th>Year</th>
<th>Income</th>
<th>Year</th>
<th>Income</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950</td>
<td>204.7</td>
<td>1932</td>
<td>47.8</td>
</tr>
<tr>
<td>1949</td>
<td>187.4</td>
<td>1931</td>
<td>63.0</td>
</tr>
<tr>
<td>1948</td>
<td>188.4</td>
<td>1930</td>
<td>73.7</td>
</tr>
<tr>
<td>1947</td>
<td>169.5</td>
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</tr>
<tr>
<td>1946</td>
<td>159.9</td>
<td>1928</td>
<td>77.9</td>
</tr>
<tr>
<td>1945</td>
<td>151.1</td>
<td>1927</td>
<td>76.0</td>
</tr>
<tr>
<td>1944</td>
<td>147.0</td>
<td>1926</td>
<td>75.5</td>
</tr>
<tr>
<td>1943</td>
<td>132.4</td>
<td>1925</td>
<td>72.1</td>
</tr>
<tr>
<td>1942</td>
<td>116.7</td>
<td>1924</td>
<td>69.0</td>
</tr>
<tr>
<td>1941</td>
<td>92.0</td>
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</tr>
<tr>
<td>1940</td>
<td>75.7</td>
<td>1922</td>
<td>59.2</td>
</tr>
<tr>
<td>1939</td>
<td>70.2</td>
<td>1921</td>
<td>58.7</td>
</tr>
<tr>
<td>1938</td>
<td>65.5</td>
<td>1920</td>
<td>70.4</td>
</tr>
<tr>
<td>1937</td>
<td>71.1</td>
<td>1919</td>
<td>64.9</td>
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<tr>
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<td>66.1</td>
<td>1918</td>
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<td>1935</td>
<td>58.0</td>
<td>1917</td>
<td>48.4</td>
</tr>
<tr>
<td>1934</td>
<td>51.6</td>
<td>1916</td>
<td>40.7</td>
</tr>
<tr>
<td>1933</td>
<td>45.2</td>
<td>1915</td>
<td>34.5</td>
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Other items from July, 1947 Supplement to Survey of Current Business.
Table 5.9
Index of Cost of New Plant in the United States
1915-1950
(1913 = 100)

<table>
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<th>Year</th>
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</tr>
<tr>
<td>1949</td>
<td>353</td>
</tr>
<tr>
<td>1948</td>
<td>345</td>
</tr>
<tr>
<td>1947</td>
<td>313</td>
</tr>
<tr>
<td>1946</td>
<td>262</td>
</tr>
<tr>
<td>1945</td>
<td>239</td>
</tr>
<tr>
<td>1944</td>
<td>235</td>
</tr>
<tr>
<td>1943</td>
<td>229</td>
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<tr>
<td>1942</td>
<td>222</td>
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<tr>
<td>1941</td>
<td>211</td>
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<tr>
<td>1940</td>
<td>203</td>
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<tr>
<td>1939</td>
<td>197</td>
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<td>1937</td>
<td>196</td>
</tr>
<tr>
<td>1936</td>
<td>172</td>
</tr>
<tr>
<td>1935</td>
<td>166</td>
</tr>
<tr>
<td>1934</td>
<td>167</td>
</tr>
<tr>
<td>1933</td>
<td>148</td>
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<tr>
<td>1932</td>
<td>111</td>
</tr>
<tr>
<td>1931</td>
<td>109</td>
</tr>
<tr>
<td>1930</td>
<td>108</td>
</tr>
<tr>
<td>1929</td>
<td>101</td>
</tr>
<tr>
<td>1928</td>
<td>108</td>
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<td>1922</td>
<td>105</td>
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<td>1921</td>
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<td>1920</td>
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<td>1919</td>
<td>159</td>
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<tr>
<td>1918</td>
<td>159</td>
</tr>
<tr>
<td>1917</td>
<td>167</td>
</tr>
<tr>
<td>1916</td>
<td>131</td>
</tr>
<tr>
<td>1915</td>
<td>95</td>
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</tbody>
</table>


The index is a product of Engineering News Record and is a measure of the relative change in value of structural steel, cement at factory, lumber, and skilled labor with "proper" weights.
pure competition, profit for the "representative" firm will
induce existing firms to expand or new firms to enter up to
a level of production characterized by an absence of windfall
profits.

There is an assumption that expectations are subjectively
certain, i.e., that expectations are constant. What un-
certainty exists is accounted for as follows. An entrepreneur
expects changes in his production function, say, or his
liquidity position. This expectation involves some antici-
pated probability distribution of such functional shifts.
The classical school hypothesizes that "there always exists
a known shift and degree of liquidity . . . that would yield
exactly the same production plans." This is known as a
certainty equivalent.

Taking sets of expectations of individuals as given,
or giving them certainty equivalents, it is possible to show
what decisions will be made and what the results will be.
The determinancy of these results will depend, under competi-
tion, on the hypothesized cost conditions of the industry.
Using, however, certainty equivalents and the representative
firm (assuming its ability to discount present prices into futures)

4 James, Clifford L., Calderwood, James, and Quantius, Frances,
Economics, New York; Prentice Hall, 1951, p 193. "Such a
period is also assumed to be sufficiently stable so that
firms may form accurate estimates of the nature and magni-
tude of a given change."

5 Friedman, Milton, American Economic Review, Vol. 39, No. 2,
May, 1949, p 197.
Table 5.10

 Marketable Securities Account of the Goodyear Tire and Rubber Company, 1915 - 1950

<table>
<thead>
<tr>
<th>Year</th>
<th>Marketable Securities</th>
<th>Year</th>
<th>Marketable Securities</th>
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</thead>
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<tr>
<td>1950</td>
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</tr>
<tr>
<td>1949</td>
<td>61,061,912</td>
<td>1931</td>
<td>16,157,023</td>
</tr>
<tr>
<td>1948</td>
<td>47,744,338</td>
<td>1930</td>
<td>7,911,789</td>
</tr>
<tr>
<td>1947</td>
<td>14,966,449</td>
<td>1929</td>
<td>25,752,850</td>
</tr>
<tr>
<td>1946</td>
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<td>000</td>
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<tr>
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<td>000</td>
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<td>3,135,000</td>
</tr>
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<td>1941</td>
<td>000</td>
<td>1923</td>
<td>799,462</td>
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<td>176,588</td>
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<td>11,197,320</td>
</tr>
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<td>9,469,180</td>
</tr>
<tr>
<td>1938</td>
<td>1,371,970</td>
<td>1920</td>
<td>000</td>
</tr>
<tr>
<td>1937</td>
<td>537,817</td>
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Table 5.11
The Deficit of the Federal Government
1915-1950
Variable 9

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<th>Year</th>
<th>Deficit</th>
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<td>1,500,000</td>
<td>1931</td>
<td>901,717</td>
</tr>
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<td>-5,149,470</td>
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</tr>
<tr>
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<td>- 733,788</td>
<td>1929</td>
<td>- 184,787</td>
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<tr>
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<td>20,676,171</td>
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<td>- 398,828</td>
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<td>- 635,810</td>
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</tr>
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<td>- 250,505</td>
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</tr>
<tr>
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</tr>
<tr>
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<td>1,176,617</td>
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<td>1918</td>
<td>9,033,254</td>
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<tr>
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Data for later years derived from figures on the National Debt. Entries for June 30 in each year.
Table 5.12
Dividends Declared by the Goodyear Tire and Rubber Company, 1915-1950

<table>
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<th>Year</th>
<th>Dividend</th>
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Table 5.13
Ratio of Sales to Inventory, Goodyear Tire and Rubber Company, 1915–1950

Variable 11

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Table 5.14
Ratio of Current Assets to Current Liabilities –
Goodyear Tire and Rubber Company
1915-1950
Variable 12

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### Table 5.15

Intercorrelations among Variables, Computation of First Factor Loadings

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\[
\begin{align*}
\sum = 3.73 & \quad 4.59 & \quad 4.56 & \quad 3.57 & \quad 4.55 & \quad 4.73 & \quad 4.56 & \quad 2.32 & \quad 1.71 & \quad 4.37 & \quad 2.65 & \quad 1.27 \\
\sum z = 22.99 & \quad \sqrt{\sum z^2} = 4.816 & \quad \frac{\sum z}{\sqrt{n}} = 0.208 \\
r_{11} = 0.78 & \quad 0.95 & \quad 0.95 & \quad 0.74 & \quad 0.95 & \quad 0.98 & \quad 0.95 & \quad 0.48 & \quad 0.36 & \quad 0.08 & \quad 0.55 & \quad 0.26
\end{align*}
\]

Source: Tables 5.3-5.11; data reduced to three digits coefficients of correlation computed by the formula:
Table 5.16

Differences Between Intercorrelations and Appropriate $(r_{11}) (r_{11})'$, Computation of Loadings on Factor II

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$\hat{\Sigma} = 6.94 \quad \sqrt{\hat{\Sigma}} = 2.634 \quad 1/\sqrt{\hat{\Sigma}} = .38$

$r_{111} = .25 \quad .21 \quad -.21 \quad -.13 \quad .14 \quad .05 \quad -.15 \quad -.32 \quad .60 \quad .57 \quad .71 \quad .76$

By inspection of residual table resulting from these loadings on Factor II, the loadings on variables 8 and 9 were changed from .71 to .80, and from .76 to .60, respectively.

The resulting residual table is given in Table 5.17.
Table 5.17  
Second Residual Table, Factor II  
(Derived Loadings Upper Diagonal,  
Corrected Loadings Lower Half.)

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<td>-09</td>
<td>-10</td>
<td>32</td>
<td>06</td>
<td>( )</td>
</tr>
</tbody>
</table>

**RIII = 0.20**,  
**$\sqrt{\hat{e}} = 1.09$,  
$\sqrt{\hat{e}} = 0.92$**

By inspection, these loadings on Factor III were changed to .20 for variable 5, .70 for variable 7, and .30 for variable 9; these corrections yielding a smaller residual table. These residuals are shown in Chapter V. The residuals from the loadings above are given in Table 5.18.
Table 5.18

Third Residual Table, Factor III

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
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<tr>
<td>6</td>
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<td>06</td>
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<td>00</td>
<td>00</td>
<td>02</td>
<td></td>
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<tr>
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<td>10</td>
<td>(  )</td>
<td>10</td>
<td>13</td>
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<td></td>
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<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>
Factors I and II were rotated for meaningfulness. Factor III has several very small loadings, and it was decided not to rotate this factor against either of the other two. The transformation equations after rotation through an angle of 13° are:

\[
I' = 0.9744(I) - 0.2250(II)
\]

\[
II' = 0.2250(I) + 0.9744(II)
\]

These equations yield new loadings as follows:

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>70</td>
<td>41</td>
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</tr>
<tr>
<td>2</td>
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<td>-15</td>
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<tr>
<td>3</td>
<td>-98</td>
<td>01</td>
<td>09</td>
</tr>
<tr>
<td>4</td>
<td>75</td>
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<td>6</td>
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<tr>
<td>7</td>
<td>-96</td>
<td>07</td>
<td>08</td>
</tr>
<tr>
<td>8</td>
<td>54</td>
<td>-20</td>
<td>20</td>
</tr>
<tr>
<td>9</td>
<td>21</td>
<td>67</td>
<td>-13</td>
</tr>
<tr>
<td>10</td>
<td>-21</td>
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<td>11</td>
<td>36</td>
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<td>-55</td>
</tr>
<tr>
<td>12</td>
<td>-39</td>
<td>53</td>
<td>30</td>
</tr>
</tbody>
</table>

These loadings were normalized and plotted on a unit sphere, Figure 5.1. The normalization process is exhibited in Table 5.21 of this appendix.
partial equilibrium analysis succeeds in avoiding the question of uncertainty reactions in any empirical sense. 6

Conceptually, equilibrium analysis exhibits the consequences of decisions in one firm on every other. In terms of currently available operational procedures for defining these movements, the theory is inadequate.

Consider the question how the rate of change for any unknown in equations (2.1) changes with respect to any parameter, say , which might be a change in expectations, tastes, technology, or financial condition. 7 An expression may be found which will answer this question. It is a rare case when one knows, however, the empiric properties (for example, slope, curvature) of functions sufficient to determine even qualitative changes in variables with respect to changes in one parameter. Quantitative consequences of decisions cannot at present be traced from general equilibrium analysis, or its special case particular equilibrium.

Input-output analysis may yield information of this nature. Leontief has developed an empirical application of

6 Cf. Simpson, Paul B., "Classical Economics and Monetary Theory," American Economic Review, Vol. 39, No. 4, September, 1949, pp 861-82, where Simpson examines the classical position with respect to the equilibrium-behavior relationship. Knight, Simpson contends, considered equilibrium first and behavior then under such a system. He thus defined the situation facing the entrepreneur, namely ignorance of the parameters of the probability distributions relevant to the outcome of his enterprise. However, the relationship between equilibrium and behavior is not clear here nor in Alfred Marshall's work, where the analysis runs from behavior to equilibrium. Simpson's work is quite awkward, however, since he is unable to distinguish between pure theory and experience.

Table 5.21

Rotated Factor Loadings and Normalization

<table>
<thead>
<tr>
<th></th>
<th>I*</th>
<th>II*</th>
<th>III</th>
<th>I*²</th>
<th>II*²</th>
<th>III²</th>
<th>h²</th>
<th>h</th>
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<th>I_h</th>
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<td>7513</td>
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<td>99</td>
<td>05</td>
<td>-09</td>
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<td>26</td>
<td>81</td>
<td>-52</td>
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<td>60</td>
<td>0414</td>
<td>2916</td>
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<td>6957</td>
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<td>36</td>
<td>90</td>
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<td>12421</td>
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<td>.901</td>
<td>32</td>
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<td>30</td>
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<td>2809</td>
<td>0900</td>
<td>5230</td>
<td>7232</td>
<td>1.383</td>
<td>-54</td>
<td>73</td>
<td>41</td>
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</tbody>
</table>

Source: Table 5.20
Equations 5.1

of this appendix demonstrate the mathematical correctness of the loadings, before rotation or normalization, on the three factors. The formula employed was:

A. First Factor Loadings Checked.

1. \[ 68 = \left( 6.19 - 78 (7.87) \right) + .61 = 67 \]
2. \[ 51 = \left( 7.07 - 95 (7.87) \right) + .90 = 49 \]
3. \[ -54 = \left( 6.02 - 95 (7.87) \right) + .90 = -56 \]
4. \[ -16 = \left( 5.11 - 74 (7.87) \right) + 55 = -15 \]
5. \[ 25 = \left( 6.81 - 95 (7.87) \right) + 90 = 23 \]
6. \[ 26 = \left( 6.98 - 98 (7.87) \right) + 96 = 23 \]
7. \[ -34 = \left( 6.22 - 95 (7.87) \right) + 90 = -36 \]
8. \[ -89 = \left( 2.68 - 48 (7.87) \right) + 23 = -90 \]
9. \[ 61 = \left( 3.30 - 36 (7.87) \right) + (36)^2 = 60 \]
10. \[ 1.07 = \left( 44 - (-08) (7.87) \right) + 01 = 1.07 \]
11. \[ 1.11 = \left( 5.11 - 55 (7.87) \right) + 30 = 1.09 \]
12. \[ 1.12 = \left( 3.09 - 26 (7.87) \right) + 07 = 1.11 \]

B. Second Factor Loadings Checked.

13. \[ 15 = \left( 68 - 25 (2.41) \right) + 06 = 14 \]
14. \[ 05 = \left( 51 - 21 (2.41) \right) + 04 = 04 \]
15. \[ 01 = \left( -54 - (-21)(2.41) \right) + 04 = 01 \]
16. \[ 18 = \left( -16 - (-13)(2.41) \right) + 02 = 17 \]
17. \[ -06 = \left( 25 - (14)(2.41) \right) + 02 = -07 \]
18. \[ 14 = \left( 26 - (05)(2.41) \right) + 00 = 14 \]
19. \[ 05 = \left( -34 - (-15)(2.41) \right) + 02 = 04 \]
20. \[ -03 = \left( -89 - (-32)(2.41) \right) + 10 = -02 \]
Equations 5.1 (continued)

21. \(-47 = \left[ 61 - (60)(2.41) \right] + 36 = -48\)
22. \(02 = \left[ 1.07 - (57)(2.41) \right] + 32 = 02\)
23. \(-18 = \left[ 1.11 - (80)(2.41) \right] + 64 = -19\)
24. \(07 = \left[ 1.12 - (60)(2.41) \right] + 36 = 04\)

C. Third Factor Loadings Checked.

25. \(15 = \left[ 21 - (05)(1.15) \right] + 00 = 15\)
26. \(13 = \left[ 05 - (-15)(1.15) \right] + 02 = 14\)
27. \(-04 = \left[ 01 - (09)(1.15) \right] + 01 = -02\)
28. \(14 = \left[ 04 - (-07)(1.15) \right] + 00 = 12\)
29. \(07 = \left[ -00 - (-05)(1.15) \right] + 00 = 06\)
30. \(13 = \left[ 12 - (-02)(1.15) \right] + 00 = 14\)
31. \(-02 = \left[ 07 - (08)(1.15) \right] + 04 = 18\)
32. \(-20 = \left[ 01 - (20)(1.15) \right] + 04 = -18\)
33. \(-10 = \left[ -79 - (-43)(1.15) \right] + 18 = -12\)
34. \(28 = \left[ 62 - (60)(1.15) \right] + 36 = 29\)
35. \(-15 = \left[ 18 - (55)(1.15) \right] + 30 = -15\)
36. \(-09 = \left[ 19 - (30)(1.15) \right] + 09 = -07\)
While recovery was underway in 1922-3, price cutting began to confront the firms of the rubber industry. Complaints of price cutting were prevalent as early as 1923. Meetings of the Mid-West Rubber Manufacturers Association were often mainly concerned with complaints of price cutting and the consequent bankruptcy of small firms. At one meeting "most of the comment (was) to the effect that the large amount of tires being dumped on the market at a low price was harming the tire trade." Further, opinion at one of the meetings was that price cutting by some of the larger companies had the effect of slowing up the demand for tires, and the uncertainty created by the reduction and the expectation by dealers and the public that other firms would follow, had "naturally" reduced current sales; that is, that price cuts made to stimulate sales were having the opposite effect. They complained particularly that reduction of tire prices was unwarranted, because of the fact that raw materials and labor were more expensive.

Whether or not the productivity of larger firms justified the price cuts, they were made. It is evident that early in the 1920's the industry was perhaps more than able to supply the requirements of the auto industry and the public. Such a situation, should tend to accentuate the reluctance of all firms to increase their long-term inflexible commitments, although it apparently did not.

Some firms, of course, trying to improve their position in the industry, used price cutting as a promotional device even when they were comparatively small. For example, a "surprise" of the industry late in April, 1922, was that the Seiberling Rubber Company, a new firm formed when Seiberling lost control at Goodyear in 1921, reduced prices approximately 10 per cent at a time when price advances had been rumored throughout the industry.

Evidence of the distaste, however, for price cutting is found in Kelly Springfield's "effort to bring about stability in the industry such . . . as exists in the older lines of trade." Kelly-Springfield announced in February of 1923 its intention of charging the car manufacturers prices approximately those paid by the tire dealer. Officers of Kelly-Springfield stated "It has been the custom to sell tires to car manufacturers at a price far below

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2. This corroborates an outline of industry growth recently formulated by Andrews. Andrews claims that the typical pattern in a new industry is that many small firms begin operation, some few mature more rapidly than others and eliminate most firms through price wars. The few remaining large firms engage in product, selling, and occasionally price competition. Cf. Andrews, op. cit., pp 175-180.
that paid by the dealer in tires . . . competition, however, grew so keen among tire manufacturers that original equipment orders were often taken at prices which yielded no profit, sales were sometime made at a loss."³

One result, then, of increasing durability and increasing plant was price cutting. Harvey Firestone claimed early in the 1920's that the industry was one of over-production. A statement from investment consultants was quoted in Chapter IV to the effect that the rubber industry had treated the consuming public too well. Generally, their subjective demand curves were "kinked."

At certain times, as Andrews notes, a firm might cut prices in the hope that a larger volume of sales ensue, and plan on increasing plant capacity in order to achieve economies of scale. This would depend upon the assumption that direct or out of pocket costs at least remain constant per unit of output, and that overhead costs fall with increasing scale of output. Seiberling, apparently, hoped for a development of this kind. More detailed examination of the history of that company might yield more information with regard to this point.

³ Rubber Age, Vol. 12, No. 9, February 10, 1923, p 333.
Manufacturers' Inventories of Finished Goods

The data in this appendix illustrate the rubber manufacturers' tendency to lag the "state of trade." Chart 6.1 depicts manufacturers' inventories at a rather high level during 1930 and certainly the picture there seems to be that tire inventories "lag" the cycle by perhaps a year.\(^1\) Abramovitz concluded on the basis of a thorough study of inventory movements in the whole economy that manufacturers' inventories are likely to lag the major business cycle by the better part of a year.\(^2\) Chart 6.1 seems consistent with this conclusion.

Table 6.1 has not been analyzed as carefully as it might have been had this study been concerned with inventory movements alone. However, if the impressions listed above are correct, two conclusions follow. First, in terms of the behavior of tire manufacturers, it seems doubtful whether even

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1 Cf. Burns, A. F., and Mitchell, W. C., Measuring Business Cycles, New York: National Bureau of Economic Research, 1946, p 78, where June 1929 is the reference date for the "peak" of the cycle. The data treated here have not been treated as carefully as would be desirable for comparison with National Bureau studies. However, by inspection it seems clear that the peak in inventories of automobile casings did not occur before this date.

"short" declines in business activity will be initiated by decreased inventory investment activity, in finished goods. This is the very tentative conclusion reached by Abramovitz, although Abramovitz is actually reluctant to come to any conclusion on this score because the evidence is inadequate.

Second, the inference seems valid that tire manufacturers do not try to "anticipate" a decline in business activity. To the extent that this is valid, the major thesis of this study is supported — namely that entrepreneurial expectations in manufacturing, or more particularly rubber manufacturing, play a passive role in the business cycle, so far as "leads" and "lags" are concerned.
Table 6.1
Manufacturers' Inventories of Automobile Casings
At Month's End, United States, 1922-36
(In thousands of casings)

<table>
<thead>
<tr>
<th>Month</th>
<th>1922</th>
<th>1923</th>
<th>1924</th>
<th>1925</th>
<th>1926</th>
<th>1927</th>
<th>1928</th>
<th>1929</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>5566</td>
<td>6261</td>
<td>6411</td>
<td>7949</td>
<td>9947</td>
<td>10432</td>
<td>9949</td>
<td>13712</td>
</tr>
<tr>
<td>February</td>
<td>6255</td>
<td>6966</td>
<td>7220</td>
<td>8928</td>
<td>11164</td>
<td>11075</td>
<td>11721</td>
<td>15495</td>
</tr>
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<td>March</td>
<td>6911</td>
<td>7561</td>
<td>7684</td>
<td>9510</td>
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<td>11583</td>
<td>12389</td>
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<tr>
<td>April</td>
<td>7286</td>
<td>8118</td>
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<td>9088</td>
<td>12461</td>
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<tr>
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<td>8611</td>
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<td>8207</td>
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Source: Rubber Age, 1922 to 1936.
general equilibrium analysis; a method of predicting changes in the demand for one product traceable to output changes in another. The output of each industry is represented in matrix form as being part of the input of every other. An inverse matrix yields terms which predict changes in output of one industry when these figures are multiplied by changes in another industry's input.  

If time lags can be accounted for, it is conceivable that such an approach will exhibit numerical consequences of decision making. It will show what the "economic" change ought to be in the input of one industry relative to a change in output of another.

However, it is not clear whether input-output analysis will be adequate to account for the manner in which entrepreneurs "modify decisions in the light of their collective consequences and a chain of situations grows up one out of another through time." An essential aspect of uncertainty is that the actor expects to know more as the future draws in toward the present. There is no evidence that input-output analysis can summarize modifications of behavior arising out of the clarification of expectations; except perhaps to show what range "economic" behavior could take in response to some change.


Chart 6.1
Manufacturers' Inventories of Automotive Casing
At Month's End, United States, 1922-26
(thousands of Casing)
Addenda Concerning the Growth of
The Firestone Tire & Rubber Company

The growth of the Firestone Tire and Rubber Company is described in a company biography, in writings by Harvey S. Firestone, newspaper items, and other sources. Certain of these items are summarized below, as they relate to the findings in this study.

A one-story foundry building, 75 x 100 feet, served as the first factory for the Firestone company, although by the time of its acquisition in 1902 the company had been selling tires for two years.\(^1\) Company archives illustrate an expansion pattern corresponding to the more general theory outlined in Chapter VI.

In 1904 the company bought a two-story building adjoining the original building.\(^2\) By 1905 plant capacity had trebled.\(^3\) In 1906 an extension was added, and the panic of 1907 found the company erecting a four-story addition and enclosing the entire plant under


\(^2\) Ibid., p 21.

\(^3\) Ibid., p 28.
this four-story plan. Plant growth is pictured on advertising copy of that period. The procedure was that of extension of existing plant, first in one direction, then in another; finally, inclusion of the whole structure under one four-story plan.

Not until 1910 did the company build a new plant, although a rim manufacturing plant had been erected prior to the construction in this year of what has been known as Plant I. Plant I was constructed so that additions could easily be made if "capacity . did not suffice" as was true in 1912 when two wings were extended. Plant I was built about the time of the first contract between Ford and Firestone for original equipment.

Plant II was erected in 1916. Lief notes that "The year opened with contracts on hand for nearly a million demountable rims . . . a harbinger of prosperity . . . passenger car production almost doubled . . ." Sales in 1916 were $44,135,325 compared with $25,319,475 in 1915. Ground was broken for Plant II and a fifth story added to Plant I along with two new five-story wings.

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4. Company Archives, Vol. I Advertising, No. 97 and Vol. II on Advertising and Sales, 1908 - 1910, No. 35. These pictures show the addition first of another story, then of another building, a third story, another extension, finally a fourth story and a four-story addition. Dr. W. D. Overman, Historian for the Firestone Tire and Rubber Company was very helpful in referring the writer to these accounts of the company's growth.

5. Lief, op. cit., p 56.
After World War I, the firm contemplated two projects which deserve some attention. The company considered moving to the West Coast with one factory, as for example Goodyear did. Harvey S. Firestone, Sr. noted the numerous economic factors favorable to such a plant: long-staple cotton fields of the West, a growing population and increasing markets, harbor facilities for natural rubber, and adequate water supplies. Nevertheless, he said that one factor prevented Firestone from opening a manufacturing branch in Los Angeles. "This factor (was) the (lack of) proper housing of thousands of employees." Mr. Firestone felt that the "country (was) expanding too fast especially in building operations". Influenced perhaps by his observations of Akron's boom in the teens (where beds sometimes were rented 24 hours per day on a shift basis) he felt that another plant in a growing area might not fare well in terms of wage demands and worker satisfaction.

The Los Angeles extension was therefore postponed. Ground was broken, however, for a new Steel Products plant to double the size of the old. Newspaper articles from the company archives describe this situation as follows:

"The Firestone Steel Products Company this month started work on its new steel products plant directly south of Plant Number 2. The building will be 250 by 850 feet and it is expected to have it under roof by October 1. (Article dateline August 25, 1919.) Orders for Firestone Rims have been more than double the capacity of the present plant it is said and the new one is being built to take care of the business."


On this same date, the archives contain an article indicating that "the fact that orders so greatly exceed production in nearly all the rubber plants has caused sudden activity in expansion throughout the Akron manufacturing district." And in September, newspaper accounts showed that Firestone had increased tire production by several thousand tires per day but expected demand to exceed production for a considerable while.

Then the files on the Steel Products Plant are blank for the period September 1919 to July 1922. The next report is dated July 12, 1922, from the South Akron Post, a neighborhood paper, reporting that "The Firestone Tire and Rubber Company is . . . making plans to occupy its new rim plant. . . Machinery is now being installed in the new plant." Apparently, all work on the steel products plant had been abandoned at once when the business decline began in 1920. The firm was completely surprised but reacted immediately to cut off extension of illiquid assets. Executives reported that June, 1922, was the biggest month in tire sales since the plant was started in 1900.


During the late 1920's the company entered into retail branch activity. Branches were started in many cities with significant investment in buildings. There are newspaper clippings on the opening of branches in Philadelphia, Richmond, Virginia, and Great Falls, Montana.10

A factory was opened in Los Angeles in 1927 and its capacity was doubled in 1929.

As an indication of the optimism of the late 1920's several other items are significant. For example:

Ground was broken in September, 1929, for an addition to Plant 2 to cost about $750,000, and to employ about 2000 additional persons. This decision was made after City Council agreed to pave an old right-of-way near the plant.11

Harvey S. Firestone, Sr., was quoted May 23, 1929, as saying that he would expand that year about $60,000 in expansion at the Fall River, Mass, cotton mills and continue to install "a quarter of a million dollars worth of new equipment in the local plant each year."12

The New Bedford (Mass) Standard reported a new bond issue of $12,000,000 for refunding, working capital, and new equipment. This was reported with the further statement that "the tire making companies are now facing . . . much heavier production requirements than had been anticipated . . . and are pressing very strongly for deliveries of tire fabric." Manomet Mill No. 4 was working full capacity with some night shifts.13

11. Akron Beacon Journal, September 6, 1929, Company Archives.
The newspaper section of archives contains no information on
expansion from 1929 to 1932.

The Fall River, Massachusetts, plants which had been purchased
in November of 1924 were sold in 1935 after strikes in that area.
A plant at Gastonia, North Carolina was purchased for "an undisclosed
price" after having been idle for several years. Newspaper clippings
infer that the price was a "bargain" as were the American Printing
Company works purchased at Fall River in 1937 for latex production.14
Plant expansion during the 1930's was motivated to a considerable
extent by the opportunity of acquiring real assets at a very low
money price.

Acquisition of the Memphis, Tennessee, plant and the Nobles-
ville, Indiana plant in 1936 reflected changing market and changing
products. 15 What investment occurred in the 1930's in the Firestone
Company was "autonomous" investment, while that of the 1920's (and
'40's) was both induced and autonomous.

14. Archives, Akron Beacon Journal November 30, 1937; Gastonia, N.C.,
papers 1935; Fall River (Mass.) Herald News, October 19, 1937 —
Company Archives.

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Books:


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Like Doctor Faustus, men often find that they have made commitments the consequences of which they could not clearly foresee. And the games of life, generally, are often over before all the rules for their conduct are clearly laid down. Whether or not the rules are clear, however, or the odds posted, decisions must continuously be made. All human action has some expectational foundation. Actions are taken on the expectation that a particular ordering of consequences is the most likely one.

In some cases, actions and their consequences are either trivial or the relationship between action and consequence is that of a one-to-one correspondence, as in the choice of a consumer good. One can imagine cases as they become gradually more involved. Static firm theory, for example, poses the problem of properly combining resources for obtaining consequent alternative outputs. Foreign policy questions are characterized by wide disagreement among a nation's citizens about the consequences of their collective action.

in the system.

"Linear programming" is a recent theoretical development concerned with entrepreneurial choice of alternative technologies. Current developments in linear programming theory do not extend to the stochastic case. This approach, while a valuable supplement to marginal theory in describing individual firm behavior, does not adequately handle responses to uncertainty. Further discussion of linear programming will be found in Appendix A to this chapter.10

C. Early Dynamic Models

Various authors, following a neo-classical approach, have extended the competitive models in an effort to take account of uncertainty. Henry Moore, Henry Schultz, C. F. Roos and others have attempted to give a formal description of the effect of demand changes which alter the existing "ecological" balance.11

Production, price, and demand, said Roos, depend upon price and rate of change of price through time, the history of prices and production, the rate of change and acceleration of production, and a cumulation of these effects. Roos thus


Articles:


*Mimeographed Reports:*


*Trade Journals:*

*India Rubber World*

*Rubber Age*
I, Clarence R. Jung, Jr., was born in Walnut Ridge, Arkansas, August 23, 1924. I received my secondary school education in the public schools of Walnut Ridge, Arkansas. My undergraduate training was obtained from DePauw University, where I received the degree Bachelor of Arts in 1947. From The Ohio State University I received the degree Master of Arts in 1949. While in residence at The Ohio State University I served as graduate assistant, assistant instructor, instructor, and research fellow. I have held the position Research Fellow in Economics during 1952-3 while completing the requirements for the degree Doctor of Philosophy.
drew attention to factors which structure the experience of entrepreneurs. These factors are the parameters of the general or particular equilibrium systems of classical economics. They are important because values which these parameters attain may "trigger off" adjustments within the whole system. Albert Hart expressed the same judgment by saying that one must guard against thinking of "business estimates as constants . . . in the economic system rather than as parameters which will shift through time in some relation to events."  

For a more rigorous summary of Roos' procedure, see Appendix B to this chapter.

Roos made a significant contribution in directing attention to expectational parameters. He was concerned, however, only with a competitive economic equilibrium and assumed the validity of Say's law. Further, he did not submit his hypotheses to statistical test although he outlined methods of doing so.

A similar example of an analysis illustrating the course which price reactions will take over time, when there is an expectational element present is given by R. G. D. Allen. As a case of the problem of "speculative" demand and supply,

Allen assumes the quantity taken from a market depends on the price, $p$, a function of time, and on the buyers' views of the rate at which the price is changing, or their perception of $p'(t)$. Writing dynamic demand and supply functions, Allen shows the conditions under which price will diverge from an equilibrium in increasing oscillations, or converge toward equilibrium in decreasing oscillations. "Speculative element" in supply must be stronger than "speculative element" in demand for a price approaching equilibrium. While this may seem intuitively obvious, Allen's analysis is successful in isolating the parametric values which must be given empirical content for the prediction of the course of prices and price reactions through time. This is demonstrated in Appendix G to this chapter.

The incremental adjustments, or discrepancies, outlined by Allen, are discussed by Weintraub as "path analysis." Weintraub notes that adjustments similar to a converging cobweb situation depend on 1) the degree of frequency of shifts in demand and supply 2) the accuracy of price forecasts and 3) the degree of output fluidity (that is, possibility of shifts in output fluidity). See also Baumol, William J., *Economic Dynamics*, New York: The Macmillan Company, 1951, pp 107-120, on comparative statics and dynamics.
small changes in output).

One further concept, introduced in the early thirties, deserves consideration at this point. Jan Tinbergen referred by horizon to the future time period relevant to formation of expectances at a given time.\textsuperscript{16} If a person makes plans at time \( t \) for a period of time of length \( k \), then his horizon is said to encompass \( t_1 + k \).

Total demand, statistically, consists in the disappearance of a commodity during a time period. Supply is the amount available at the beginning of the period, plus risk stocks for unexpected changes plus regular trend production.

Tinbergen assumes that demand varies inversely with horizon and directly with total supply.\textsuperscript{17} If statistically supply increases considerably but disappearance does not, one may assume a long horizon. For certain commodities (in particular coffee) it did appear that where overproduction existed, sellers "in a still higher degree behave(d) as if their horizon were widening."\textsuperscript{18} Thus when stocks were above customer requirements, sellers perceived this discrepancy in an exaggerated fashion.

This serves as a useful indicator of increased horizon.


\textsuperscript{17} The process by which this hypothesis was derived is not clear in Tinbergen's article.

\textsuperscript{18} \textit{Ibid}., p 252.
and the tendency to magnify bad news, but as in similar approaches, it does not summarized adequately the underlying reasons for lengthening of perspective. (In later chapters, limited theoretical and empirical considerations seem to argue that the amplification of adverse signals is a general behavioral tendency.)

Another question considered by Tinbergen concerns the factors on which dividend expectancies depend. Plotting worth (W) of stocks (price times long-run government interest rate) against dividends, Tinbergen found that the following relations held for various continental stocks, 1931-32:

\[ W = 1.5 \times 0.47 \times D. \]

"The chief determinant" of W was the last dividend paid. However, the expectance was that the next dividend payment would be only about half as abnormal as the last.\(^{19}\)

Graphically the character of dividend expectancies may be illustrated as follows:

![Figure 2.2](image)

\[ D = \text{Dividend Payment} \]
\[ D_0 = \text{"Normal" Dividend Expected} \]

At each moment expectances tend to gravitate toward "normal."

\(^{19}\) Ibid., p 261.\_
These expectances are indicated by the dotted lines, in Figure 2.2.  

One interesting conclusion is that immediately previous earnings are closely associated with expectances. Tinbergen found in his statistical tests of the business cycle that investment was most closely related to immediately prior profits. Looking ahead to Chapter 3 it might also be noted that Bronfenbrenner and Friend found in 1950 that failure of investment plans significantly hinged on failure of expected sales or earnings. Keynes hypothesized that we expect what is, to continue. Tinbergen says people expect what is will continue, but will be only about half as favorable, or unfavorable, as before.

A study which did much to incite interest in subjective uncertainty (on the micro level) appeared more or less contemporaneously with the models outlined above. Chamberlin's work on monopolistic competition is too well known to warrant summary here, but its explicit recognition of subjective demand curves, uncertainty about the effects of selling expenses and product policy, and other indeterminancies is significant. 20

Another work too widely known to warrant summary is, of course, Keynes General Theory. The formal interdependencies examined there constitute the foundation for other studies investigating parameters of states of mind with regard to

business operations.

D. Albert Hart

By the end of the 1930's, Hart came to the conclusion that theoretical literature on dynamic economics required a theory of the firm under which business estimates could be given a more clearly defined role. Hart found it useful to quote from Shackle saying that dynamic analysis involves:

1. Taking the sets of expectations held by different individuals as given . . . to show what decisions will be taken at this moment and what will be their immediate consequences, before they are themselves modified in the light of their first effects.

2. (Showing) how these decisions will in fact be modified after a short interval in the light of their own collective consequences, and thus to build up a chain of situations growing one out of another and representing a process in time.21

In 1941, Hart presented a theory of the firm designed to describe the decision making processes of the firm under various certainty assumptions. He examined situations where 1) a firm has perfect confidence in its estimates 2) subjective certainty prevails but rationing, price fixing or capital rationing modify action and 3) allowances are made for uncertainty. He examined finally the origin of expecta—

tions, their realization or non-realization, and the formation of new sets of expectancies.

The essential nature of uncertainty reactions, according to Hart, is the preservation of "flexibility in planning, with a view to making the most of later opportunities to improve estimates." The predicament in which the entrepreneur finds himself is that of expecting that subsequent information will enable him to make a better decision. Yet he cannot wait for that information before making some decision. Hart's hypothesis is that he compromises. He commits liquid resources to illiquid forms, but he hedges in various ways: he may buy insurance, reduce inventories, keep a "comfortable" cash balance, or use unspecialized equipment or even rent equipment.

What reactions will occur in the several states of uncertainty which one may imagine entrepreneurs to experience? Hart sets them out as follows.

Under subjective certainty, with no market discontinuities, an entrepreneur will choose the production plan (including input-output quantities, market and finance schedules, which recent studies have shown to be important) under which the present discounted value of the net receipts is greatest. The rate of interest enables him to account for the future in taking

22 Hart, op. cit., p 55.
his present actions.

However, uncertainty questions are not absent. Two important problems arise. First, there is the joint cost problem created by the use of durable goods. Goods produced by the same machine through time share as a cost of their production the costs of acquiring and maintaining the machine. An entrepreneur, though he may not fear the future, is still uncertain how to compute the value to his firm of such durable equipment. In some measure, this is the traditional joint cost problem; in part, it is the lumpiness of machines and the vagueness of returns to scale. And if the equipment is unspecialized, its use at one instant may affect its use at other times (as Keynes noted when he considered the role of user cost).

Second, although the entrepreneur may solve the durable goods problem by noting differences in alternative replacement and expansion plans, there remains the question of plant layout. A plant layout which involves a high proportion of direct to indirect costs is a hedge against market shifts, according to Hart. With a given investment, a large proportion of variable costs is a means of maximizing profits despite market shifts. Production in the short run as long as revenues cover variable costs is a textbook commonplace. Hart contends that it is helpful to emphasize variable-fixed cost proportions as
What happens if an entrepreneur revises his anticipations? Supposing the entrepreneur finds that he has made a mistake, the question arises concerning how he forms new plans. These new plans, according to Hart's assumptions about subjective certainty, include the assumption that he could not err again. Suppose, assumes Hart, his revision of selling estimates is pessimistic. For a short time, say a week, he will probably cut back production, so that incremental costs and revenues become equal again. However, if storage of the final product is possible, the production decline will be less than the sales decline, because production may be for future dates.

For revisions covering a longer stretch of time, the same behavior seems likely (based partly on perishability of product), but it is important to remember that the summation of a number of partial revisions is not equal to one total long-term revision. One big revision may mean bankruptcy, and the production change may be gradual because of previous commitments and the costs of a change.24

What occurs if the whole schedule of expected future rates of interest change? Readjustments will, of course, be made in

23 Marx contended that entrepreneurs would tend to use as much labor (variable cost) as possible, though his analysis was not premised on uncertainty grounds. However, on an impressionistic basis, it seems doubtful whether employers currently attempt a high variable-fixed cost ratio (especially as will be seen in the rubber industry) where labor has certain fixed cost aspects. A presumption against debt financing is grounded in uncertainty considerations.

Finally, man seems unique in the animal world in his pursuit of assurances about either the meaning of life itself or the consequences of death. These cases and all others of the "real" world might be conceptually represented as an expectational spectrum, ranging from the most simple to those which seem likely to remain ambiguous indefinitely.

No attention will be given in this study to most of these possibilities. In particular, this study is limited to business expectations as they relate to decisions to enlarge existing buildings, install new equipment, or build completely new capacity.
the direction of equating discounted increments of cost and revenue. If the expected interest rates decline, all marginal revenues gain in discounted value and those of a long-run nature gain more. However, the increase in input accompanying the increases in expected receipts from long-run investments will eventually raise marginal revenue productivity of short-run investments, after physical productivity of the long-run investments begins to be evident.25

Under market discontinuities (for example, price control or capital rationing) the entrepreneur is faced with a more difficult uncertainty situation. His actions are correspondingly more complex. In general his hedging activities are more numerous because he wishes to convince "outsiders" that he is in a strong position. It is important for the firm to acquire flexibility even though it may feel no uncertainty about the future, mainly because this contributes to a better reputation vis a vis the people who supply control over earning assets. A firm will increase its liquid assets to avoid a chain of adverse incidents that might be set up by its inability to meet one relatively small crisis, referred to later by Hart as a

25 On the surface, Hart notes, this appears to be similar to Hayek's interest theory of the business cycle. However, Hayek has implicit assumptions about compatibility of inter-firm plans and estimates which Hart does not include in his analysis. It is helpful to recall at this point that we may divide our thinking into 1) that associated with a firm's decisions 2) the consequences of a firm's decisions for itself or 3) for others and 4) the revision of plans and estimates within individual firms. Hart does not attempt to analyze inter-firm phenomena. See Appendix G, this chapter.
The linkage of risks. The firm may take out more insurance, and maintain a more favorable current ratio of assets and liabilities. It will try to be more "respectable," in order 1) to maintain its access to earning assets and 2) to obtain access to those assets at the lowest possible "step" of their cost structure.

The maturity restriction, for example, placed on some loans (the restriction that funds may be used only for some particular purpose) may even be sufficiently important to affect the asset distribution within the firm in the event that it may be forced to consider acquiring certain new types of collateral to get additional loans. That is, it may be profitable for a firm to invest in cash in order to convince a prospective lender that it is a good risk. Or its flexibility may be so limited that the maturity restriction actually places limitations on what the firm may do with the additional purchasing power. The uncertainty of their position relative to capital rationing creditors may induce firms to increase their flexibility provisions.

Under subjective uncertainty, an entrepreneur may assume that there can be an indefinitely large number of receipts schedules through time, each of which he may assign some particular

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27 Weintraub notes that uncertainty affects plant layout because of Lenders' Risk and Borrowers' Risk, the Borrower fearing default and the "stigma of bankruptcy." Weintraub, *op. cit.*, p 348.
degree of probability (a cardinal number, though this may be open to question). If one sums the alternative receipts for each day, weighted by their subjective probability, the result is what Hart terms the Expected Receipts Schedule. Graphically this is illustrated as follows:

Figure 2.2

where E is the weighted average of all expected receipts schedules. 29

Since one may conceptually employ this procedure for any aspect of the firm's planning, Hart notes that we might be led to believe that these expectation curves could be compared and the best selected. However, this is not possible since an entrepreneur may feel either an aversion for risk or a liking for danger. Further, these curves do not take into account the possibility of later decisions when fuller information is available. Quantification the writer believes would be very difficult if not impossible with currently available operational procedures. Finally, Hart considers

29 This is Marschak's definition of "expected value." See Marschak, Jacob, "Lack of Confidence," Social Research, Vol 8, No 1, February, 1941, pp 41-62.
the "dispersion of prices or gross receipts" more important than the "expectation value."\textsuperscript{30}

Hart illustrates the role of flexibility as a reaction to uncertainty in profit maximization as follows:

Assume a situation where for each scale of output there is an unambiguously defined optimum input plan. Let market expectations be shown as $r_1$, $r_2$, $r_3$, and $R$ be the Expectation curve.\textsuperscript{31}

![Figure 2.3](image)

The optimum output is the point where $R$ lies farthest above $TC$. But if the entrepreneur expects further information and "if he is free to alter his provisional plan when the information comes in, there is a different answer." Suppose, for example, that he is certain at time $t_0$ that by time $t_f$ further information will make it sure which of the contingent selling-market situations will exist at say $t_k$. We may then draw a revised cost curve $C'C'$ showing the "cost of each output if operations to date $t_f$ are adapted to an output $x_n$.

\textsuperscript{30} Hart, op. cit., p 55.

\textsuperscript{31} Ibid., p 57.
and operations from \( t_f \) to \( t_k \) modified to fit the output in question. By construction, the two curves must coincide for \( x = x_n \) and \( C'C' \) must lie higher than \( TC \) for other outputs (\( TC \) assumed to be optimum, it will be recalled).\(^{32}\)

The vertical distance between curves will represent the cost of shifting from output \( x_n \) to the final output. This will be greater as the size of the shift is greater and as date \( t_f \) is nearer \( t_k \). The \( C'C' \) curve will be different according to the value of \( x_n \) selected. As \( x_n \) decreases, the left hand branch of \( C'C' \) will rise; the right hand will fall.

The entrepreneur chooses among alternative cost curves. He should choose a \( C'C' \) offering the largest expectation of net revenue on the original set of contingent selling market estimates, allowing for the cost of shifting. This is a problem at this point which is similar to sampling problems. When does it cost more to sample further than the resultant accuracy is worth? When does the cost of shifting become more than the resultant maximization of income resulting from

\(^{32}\) Ibid., p 58.
adaptability? No precise answer is possible. But the nature of the problem is clear. Furthermore, "ordinarily it will be worthwhile to adopt a plan which makes C'C' higher than TC at output $x = x_n$ in order to reduce the cost of shifting in the more likely event that some output other than $x_n$ will be selected.\textsuperscript{33}

Thus a policy of flexibility leads to a yield worse than a correct "hunch," as does a minimax solution, to be outlined later. But if the hunch is incorrect, as it is likely to be - flexibility leads to a better final situation. Moreover, the existence of several types of output, uncertainty of technology, uncertainty of buying prices and interest rates, will plainly increase the "inducement to lay plans so as to leave room for change."\textsuperscript{34}

Behavior through time for individuals facing uncertainty is characterized then by certain features, according to Hart. First, entrepreneurs are likely to be reluctant to hold durable equipment more than they think absolutely essential. Second, they will wish to avoid long-term buying contracts. Third, they will choose to produce products whose intermediate forms are unspecialized and capable of storage. Fourth, they will choose processes where the bulk of the input comes near

\textsuperscript{33} Ibid., p 59.

\textsuperscript{34} Ibid., p 60.
the output date. Fifth, they will engage in certain other uncertainty reactions such as insurance buying, acquisition of liquidity, and so on.

The extent to which it will be worth sacrificing higher net receipts (in case expectations were certain of fulfillment) for flexibility depends on 1) the technological opportunities for flexibility and 2) the degree of dispersion of market anticipations about the Expectation curve. Thus, one of the chief responses of firms to technological change is maintenance of flexibility sufficient to adapt to it.

Discontinuities in capital markets help to explain the "business man's craving for 'liquidity' and his willingness to buy insurance the rates of which include charges for administrative expenses and fraudulent losses." A firm realizes that small losses now may bankrupt the concern, but there is no correspondingly immense gain for small favorable events. The results of small losses and small gains are asymmetrical. Liquidity and insurance increase a firm's credit rating, make it able to ride out storms, permit it to take advantage of buying opportunities.

35 Friedman and Savage have examined the question why individuals will buy insurance which replaces an uncertain large loss with a certain small loss and at the same time buy a lottery ticket which places the buyer in another uncertain situation, with a good chance of losing the price of the ticket. The explanation given by Friedman and Savage turns on the high marginal utility of the money which would be lost if an uninsured catastrophe occurred as compared with the small marginal utility of the money which will probably be lost on a lottery ticket. Cf. Friedman, Milton and Savage, L. J., "The Utility Analysis of Choices Involving Risk," Journal of Political Economy, Vol 56, No 4, August, 1948, pp 279-304.
Are there uncertainty reactions in Hart's scheme which can be defined as belonging to a personality trait which craves danger? Behavior typical of such a trait would be that of avoiding flexibility devices and risking all on a hunch. Conceivably an experiment to test this trait might be devised within Hart's conceptual framework. Generally, however, since adoption of devices for reducing uncertainty are also devices for maximizing income over a period of time, the effects of uncertainty reactions and risk aversion are qualitatively indistinguishable.

The origin and revision of estimates constitute a crucial question in the economics of uncertainty.

What are the sources of estimates? With respect to technological estimates, inter-firm influences are not important, according to Hart, since "experts" within the firm can usually settle questions.

With respect to marketing estimates the firm must predict what other firms anticipate, and how other firms will revise their estimates through time. No good formula exists for making market estimates, whether competitors are few or many, according to Hart, although curve fitting techniques might be useful.

Executives also have information on general cyclical movements, politics, episodic events, and so on from newspapers.
These items, Hart says, must strongly influence a business man's view of the "normality" of a situation. However, Hart cannot accept the view that the direction in which businessmen revise estimates in the light of such information is in general amenable to demonstration.

This study seems to indicate that Hart is generally correct in this regard although he is probably underestimating the degree to which executives structure their experience around a few simple, meaningful, and operational concepts.

The critical question arises concerning how the revision of estimates related to disappointment in the original ones is made. Uncertain anticipations include the expectation that expectations will change. "Confirmation of initial expectations is not incompatible with revision of estimates, on the contrary, it implies a certain sort of revision." Thus one cannot always distinguish between disappointment and revision.

Hart, therefore, sets up certain "conditions for satisfaction of anticipations."

Entrepreneurial estimates from $t_o$ to say $t_2$ include:

1) A probability distribution, $F_o(P)$ of possible prices with an

\[36\] Hart, op. cit., p 84.
expectation value \( E_0(P) \), and 2) a set of contingent probability distributions which it is thought may exist at \( t_0, t_1, t_2 \). These are \( F_1a(P), F_1b(P), \ldots F_1n(P) \) and their expectation values will be \( E_1a(P), E_1b(P), \ldots E_1n(P) \). Each of these contingent distributions is assigned at time \( t_0 \), a certain probability; their weighted sum will give \( F_0(P) \).

In tabular form these appear as follows:

Table 2.1

<table>
<thead>
<tr>
<th>Function</th>
<th>Prob of Function</th>
<th>( E(P) )</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>( F_0(P) )</td>
<td>1.00</td>
<td>2.275</td>
<td>0</td>
<td>0.1</td>
<td>0.275</td>
<td>0.3375</td>
<td>0.225</td>
<td>0.0625</td>
<td>0</td>
</tr>
<tr>
<td>( F_1a(P) )</td>
<td>0.25</td>
<td>4.000</td>
<td>0</td>
<td>0.0</td>
<td>0.00</td>
<td>0.250</td>
<td>0.500</td>
<td>0.250</td>
<td>0</td>
</tr>
<tr>
<td>( F_1b(P) )</td>
<td>0.50</td>
<td>2.700</td>
<td>0</td>
<td>0.1</td>
<td>0.30</td>
<td>0.400</td>
<td>0.200</td>
<td>0.000</td>
<td>0</td>
</tr>
<tr>
<td>( F_1c(P) )</td>
<td>0.25</td>
<td>2.100</td>
<td>0</td>
<td>0.2</td>
<td>0.50</td>
<td>0.300</td>
<td>0.000</td>
<td>0.000</td>
<td>0</td>
</tr>
</tbody>
</table>


The probability of each price under \( F_0(P) \) equals the weighted sum of the probabilities under the \( F_1s \); and \( E_0(P) \) equals the weighted sum of the \( E_1s \). The \( F_1s \) will equal the weighted sums of estimated distributions between \( t_0 \) and \( t_2 \).

This is an illustration of the "law of compound probabilities."

See Hart, op. cit., p 84.
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Certain necessary relations follow from this table. First, no price is possible under $F_0(P)$ which is not recognized as possible under at least one $F_1$.

Second, the range of $F_1$'s is normally less than the range of $F_0(P)$ and the concentration of each $F_1$ will be normally greater than the concentration of $F_0(P)$.

Third, at $t_0$ expectations will be that the eventual $F_1$ will lie roughly in the center of the range of $F_0$ and will have an expectation value close to $E_0$.

The necessary conditions for fulfillment of expectations are as follows:

a. Prices between $t_0$ and $t_1$ must follow the schedule of expected prices, or values.

b. Estimates made at $t_1$ for each later date must have the same expectation values as estimates for these same dates existing at $t_0$.

c. $t_1$ estimates must not increase the range of possibilities as compared with $t_0$ estimates. Range, that is, must have narrowed.

d. The dispersion (for example, standard deviation) of estimates must decrease.

Obviously, failure of condition a. is the only case referring to market experience different from that expected. Failure
of condition a. may in fact lead a firm to revise its
dispersion estimates on the assumption that they overlooked
something, or that their estimating procedure was at fault.

Failure of condition b. merely means that some factor
was not previously weighted correctly. This does not appear
to Hart to be the most critical condition.

Failure of c. indicates cropping up of possibilities
not contemplated at $t_0$. "The range," however, in Hart's
analysis "is a relatively unimportant aspect of the entre­
preneur's distribution of estimates."

Failure of condition d. will reflect receipt of informa­
tion earlier or later than expected, or in unexpected
detail, or completely unexpected and unsettling information
(for example, war, or rumors of bank failure). "There is
thus a presumption that radical surprise on the firm's buying
or selling markets between $t_0$ and $t_1$ will tend to encourage
expansion of operations if agreeable, to encourage contraction
if disagreeable, through effects on expectation values. The
supplementary effect upon the dispersion of anticipations,
however, is likely to be adverse to investment in either case."38

What operational examination could be made of Hart's
explanation of entrepreneurial investment behavior? With
reference to condition d., the following procedure is suggested.

38 Hart, op. cit., p 87.
At arbitrary time \( t_0 \) inquire of an entrepreneur what income (or price, or other variable) he expects at some time, say \( t_1 \). Inquire of him within what limits he believes the odds are 2 to 1 that the price, or income, will certainly be contained. If possible, inquire of him what he thinks the probability of several income figures to be. Measure, by some standard procedure of attitude measurement, the intensity of his desire to invest in this field.

At time \( t_1 \) inquire of him again the limits within which he believes the chances to be 2 to 1 that the value of the variable will be enclosed. Note also what the market experience of the values of this variable has been. Measure again the entrepreneur's desire to invest in the field, or if possible observe his actual investment behavior.

If the dispersion of price estimates increases, and the entrepreneur's desire to invest in this field decreases, Hart's hypothesis in this case receives empirical support. If the measured intensity of desire can be validated in terms of actual investment the experiment will be more convincing. This might constitute a method of testing the importance of trends in the second moments of income expectations.\(^{39}\)

More indirect tests are possible, also. Hart's thesis is supported if we find that the effects of unsettling information cause delay in investment decisions and that unfavorable reports bring disinvestment or non-investment more quickly than favorable news elicits investment. These circumstances may be examined without the direct interview method described above.

Empirical verification of the presence of dispersion is difficult. Indirectly, a researcher could infer that where, within a corporation, estimates of the future do not fall into a simple and consistent pattern, wide dispersion exists. This is not a precise statistical treatment but where data are available, the weight of evidence should prove convincing in one direction or another.

A non-static theory of production should be capable of representation in model form. To this end, Tintner examined conceivable uncertainty situations, quite similar to those outlined by Hart. Uncertainty, according to Tintner, consists in a probability distribution of the parameters of distributions of expectations. Tintner outlined possible models of a single-valued anticipational situation involving linear functionals. Three cases are cited: 1) The individual projects the present value (or some weighted value) of a variable into the future.
2) The trend may be projected into the future. This introduces first, and perhaps higher, derivatives. Possibly the curvature or other geometrical properties will influence anticipations. This area belongs to the calculus of variations where answers would be complex but not necessarily incapable of statistical verification. 3) One particular point in the past may uniquely influence anticipations. This belongs to the area of difference equations; economic examples of which are impulse situations examined by Ragnar Frisch and others.

Tintner's approach does not differ much from Hart's on theoretical grounds. It does show areas of mathematics relevant to various model types, and is unquestionably one of the most important theoretical formulations of the problem.40

E. G. L. S. Shackle

While Hart emphasized the attention which entrepreneurs are likely to give to the dispersion of estimates through time, Shackle has been more concerned with the limits within which entrepreneurs look upon investment action as feasible, taking into account uncertainty of outcome. Hart's analysis describes entrepreneurs as they attempt to retain their

flexibility while liquid resources are being committed to illiquid form. Shackle emphasizes the manner in which entrepreneurs take account of the possibility that they will be confounded in their estimates of the future value of liquidity.

Shackle contends that two forces tug at an entrepreneur in making decisions. One is the enjoyment by anticipation of the possible reward. The other is the fear that he will not enjoy a reward at all - that the adventure will fail.

Likewise the pain of loss is matched against the potential surprise that such a loss could happen. Shackle expresses it that

"an enterpriser who is deciding whether to invest or not will place himself in imagination in the position of having actually laid out a cash sum on constructing concrete equipment, and will then weigh against each other the two elements of the immediate mental experience which this position would afford him: the enjoyment by anticipation of the greatest gain whose attractiveness is not undermined by association with too high a degree of potential surprise, and the suffering by anticipation, of the greatest loss whose unpleasantness is not weakened by being associated with too high a degree of potential surprise. It is these two extremes which focus the enterpriser's attention."

This is not a concept based on a frequency notion of probability. Shackle contends that such notions do not apply because for most entrepreneurial decisions there are not sufficient trials. Nor do the two extreme points, noted above,

---

correspond to the limits of a range of estimates, as Hart has suggested.

Shackle assumes that individuals can compare the potential surprise they would feel with respect to the non-occurrence of particular events. For the various values which an entrepreneur estimates certain variables will take in the future, there will be various degrees of potential surprise. For some values, he will feel no potential surprise, for others some surprise, for others a great deal, and for others he will feel completely surprised. In case the estimated values refer to a continuous variable, say \( x \), this may be depicted graphically as follows:

Figure 2.5

![Diagram](image.png)

where \( \bar{y} \) represents the absolute maximum of potential surprise. Shackle has only introspective evidence for the general form of this potential surprise curve.

One should note that Shackle does not consider the mean of the possible values to be significant, as does Hart; Shackle believes the hypotheses of success shown on the chart above to
mutually exclusive, and not additive.\textsuperscript{42}

Total intensity of enjoyment Shackle hypothesizes to be a decreasing function of potential surprise. If total pleasure, say 0, is plotted against potential surprise, say \( y \), and the outcome of the project, say \( x \), then there results a total stimulation surface in three dimensions.

If any point on the stimulation surface is projected on to the \( xy \)-plane, it will fall obviously on a \( y \)-curve, which Shackle labels a contour line. Following this contour line down to the point where it intersects the \( x \)-axis yields a standardized focus outcome. There is the standardized focus gain at one extreme of the inner subset of outcomes bearing no potential surprise, and a standardized focus loss at the other extreme. These denote the reward or loss, which if they occasioned no surprise, would be equal in stimulation to a larger reward or loss occasioning some surprise. These concepts are extremely important in Shackle's analysis.\textsuperscript{43}


\textsuperscript{43} Weintraub distinguishes between most probable prices subjectively determined and the "effective" price after allowance for uncertainty. This, like Shackle's analysis, is merely a restatement of the principle of certainty equivalence. However, Shackle extends his formal model to include important and to a certain extent novel qualitative conclusions while Weintraub offers no new contribution. Cf. Weintraub, op. cit., p 340.
An important result of Shackle's thesis is that if there are "changes in the form of the potential surprise curve such that some values of x carry higher but none carry lower potential surprise than before, then the corresponding standardized focus outcome will move to a numerically smaller value of x." This is because the rate of change of the total stimulation function with respect to increasing surprise is negative for all y except $y = \bar{y}$. This may seem trivial. It argues, however, a more subtle point: The effect of increasing surprise concerning some investment possibility is that of decreasing the potential investment range.

The predicted effect of surprise on the potential investment range (that it will decrease) is the same conclusion that Hart draws. However, revision of estimates Hart believes is normally associated with increasing certainty as time passes. Hart would contend that a person should not be at all surprised if previously unavailable data prove his initial judgment too skeptical, while Shackle argues that changes in potential surprise are logically confined to increases. The predicted effect of surprise on the potential investment range (that it will decrease) is the same conclusion that Hart draws. However, revision of estimates Hart believes is normally associated with increasing certainty as time passes. Hart would contend that a person should not be at all surprised if previously unavailable data prove his initial judgment too skeptical, while Shackle argues that changes in potential surprise are logically confined to increases. The predicted effect of surprise on the potential investment range (that it will decrease) is the same conclusion that Hart draws. However, revision of estimates Hart believes is normally associated with increasing certainty as time passes. Hart would contend that a person should not be at all surprised if previously unavailable data prove his initial judgment too skeptical, while Shackle argues that changes in potential surprise are logically confined to increases.

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44 Shackle, op. cit., p 27.

45 Ibid., p 28. "A man cannot logically at one and the same time say to himself: 'I shall be surprised if x turns out to have a higher value than so and so; but I shall not be surprised if this judgment turns out to be wrong.'" However, the time assumptions behind this statement are not clear. When a person draws in his thinking a potential surprise curve it presumably is his best estimate at that time. However, at a later date this surprise curve may not even be relevant. "Only the first move of a plan can be implemented" at first, and at a later date the situation may comprise a "new" venture. Cf. Modigliani, Franco, discussion on "Measurement of Expectations," Econometrica, Vol 20, No 3, p 481.
view seems to be the more convincing one.

"Surprise" is defined by Shackle in terms of the subjective feelings of the entrepreneur. What would "surprise" one person, or firm, would not "surprise" another. Some firms may be basically pessimistic and others basically optimistic. Shackle gives us no operational definition of surprise and this handicaps empirical investigation. 46

An example will illustrate this: Suppose a firm finds itself unable to fill current orders even with three eight-hour shifts a day. A "pessimistic" firm will predict this to be a temporary situation. An "optimistic" firm will view this as a forced expansion or "forced investment" situation. Shackle does not help us to demonstrate empirically the

46 In fact Shackle's psychology is somewhat close to the "felicific calculus" in its oversimplification. Even limited investigations of behavior in games of chance show that motivation is much more complex. Preston and Baratta, in studying individuals bidding on uncertain outcomes, note that "irrational" behavior may differ from "rational" behavior because the prize has a psychological value different from its objective value (say, money value) or because the price paid (the bid) has a psychological value different from its objective value. Further, they found that there is empirical evidence to show that "prizes with small probabilities are paid for too generously and prizes with large probabilities are taken as bargains." Their experiment indicated that this distortion of perception of mathematical probability seemed to be generally valid even for individuals with formal training in probability theory. See Preston, Malcolm G., and Baratta, Philipp, "An Experimental Study of the Auction-Value of an Uncertain Outcome," American Journal of Psychology, Vol 61, No. 2, April, 1948, pp 183-193.
Chapter I
INTRODUCTION

A. Investment and Uncertainty

Decisions to invest money in plant and equipment are uniquely important in an economic system characterized by predominantly private ownership of resources. In such an enterprise economy, investment opportunities are accompanied by insufficient information and uncertainty. Entrepreneurs must rely on their expectations about the future as guides to their present behavior. Replacement or extension of capital facilities thus rests on an association of future hypothetical conditions with particular future dates, and particular degrees of belief about the effects of one's own future behavior - which combination may be termed an expectation. It is the purpose of this study to examine expectations, their origin and change, realization or non-


2 Shackle, G. L. S., Expectation in Economics, Cambridge at the University Press, 1949. An important question may be raised whether this approach does not involve a "dualistic" position, dividing investment phenomena into mental and behavioral systems. Since any investment action can be accounted for in a strict behaviorist system, the introduction of expectational analysis might seem to be either an irrelevant or a metaphysical exercise.

An expectation is, however, merely a convenient construct which describes the mental process which takes place between the stimulus of investment opportunity and the response of investment (or non-investment). If it is predictively efficient, it is contingently accepted.
Shackle does not neglect, however, the important question of what happens to expectations when unanswered questions are resolved. A basic expression of the general problem of uncertainty is the ambiguity surrounding response possibilities. For many problems one may properly assume that through time answers to some questions will become available. Entrepreneurs and others never find it possible to wait for all information to come in, but they may wait for a portion of it. Hart deals with this problem at length. Shackle handles these questions as follows.

Returning to the potential surprise curve, assume that answers A and B are associated with the appropriately labeled curves below. Assume that the entrepreneur would not be at all surprised to see either A or B correct, or that he would be completely surprised. Prior to the time when the correct answer becomes available, the y curve will be defined by A for negative values of x and B for positive values of x. Shackle asserts this on introspective grounds.

Figure 2.6

47 Gambler indifference curves, defined later, relate to personality traits. Modern communication theory would describe the "optimistic" and "pessimistic" firms as firms having different channel capacities - or having different needs for "redundant" data in helping them make production decisions.
There results a somewhat (to our intuition) surprising conclusion. Whichever alternative occurs (A or B) "the effect will be to give some values of \( x \) a higher, but to none a lower degree of potential surprise than before."

The clarification results in a reduction toward the "center" of the curve the "inner subset" of values enclosed by the standardized focus outcomes. The conclusion is that if the rival hypotheses (A and B) carry nil surprise, the enterpriser can attach nil potential surprise to an inward shift in the standardized focus outcomes.

However, "the idea of any movement, however small, outwards must carry potential surprise greater than zero, and a degree of potential surprise increasing rapidly with increase of the size of the movement."

Phrased differently, this means that an individual is

\[ \text{For if } x \text{ remains constant but } y \text{ increases, since } \frac{\partial \phi}{\partial y} < 0, \] the new primary focus outcome must stand on a lower contour line. Likewise if \( x \) increases, but \( y \) remains the same so that the new primary focus outcome is a point on the old \( y \) curve, this must be a lower contour line, else it would itself have been the maximum contour line touched by the old \( y \) curve. These terms are more carefully defined in Appendix D to this chapter.

Suppose the rival hypotheses do not carry equal potential surprise, but that B involves some potential surprise while A involves none. The entrepreneur will assign them "either the surprise denoted by curve A, or the degree of potential surprise accorded the truth of answer B, whichever is lower."

\[ \text{Ibid., p. 58.} \]
not necessarily surprised if a venture turns out to be not quite as bad as he thought, but he must be surprised if it is better than he originally figured it would be. Further, he will not necessarily be surprised if it appears not quite as good as he thought, but he will be surprised if it looks worse. The predicate adjectives "good" and "bad" refer, more rigorously, to focus-gain and focus-loss, respectively. 

In two ways this entrepreneurial structuring of experience may result in liquidity measures. First, as of two ventures, A and B, B may currently have such a high focus loss as to inhibit the individual from investing in this field even though there might be a high focus gain. This is because at some time, say t, a question might be answered which would so decrease the focus-loss of B that the entrepreneur would then invest there. It has been shown that he could attach zero potential surprise to such occurrence, under Shackle's scheme. This may cause the entrepreneur to remain in a liquid position from the present until time t.

Why, it may be asked, does he not invest in A; then when B looks better, sell the concrete assets of A and invest in B?

"This is the heart of the problem of 'liquidity'." A man may

52 Ibid., p 34. "... it is in the nature of standardized focus outcomes that the investor will attach some degree greater than zero of potential surprise to the idea that the focus-gain or focus-loss of a blueprint of distant construction might increase as the present moment advances toward that date." But "he can . . . attach zero potential surprise to the idea that either of them may decrease."
hole expectations which he "cannot persuade others to believe in."^33

The investor in this example does not necessarily attach zero potential surprise to a decrease in focus—loss of B but he may do so, and if he does, this type of liquidity action will take place. It does not necessarily occur.

Second, an entrepreneur might remain in a liquid position because he associates surprise with an increasing focus—gain. This was pointed out above.

Partly, of course, behavior in such a situation will depend upon the time interval from the present to time n. "Impatience" will tend to cause present investment in A. The possibility of enjoying by anticipation the results of successful investment in B, however, will result in liquidity responses. Introspective evidence, on which much of Shackle's analysis is built, convinces him that this is correct. He buttresses his position with various types of impressionistic evidence. The immediate disclosure of a previously unspecified vacation date from school disappoints us, he says. Further, a man may risk his fortune prospecting for gold; he may refuse to risk it on cutting a pack of cards. Behavior through time is not conclusively handled here, nor does Shackle deal adequately

^33 Ibid., p 67.
with problems of strategy. Thus, Shackle's analysis of the expected clarification of expectations is incomplete although he has outlined apparently two strong motives for liquidity measures.

When a surprising event does occur (as compared with its expected occurrence or non-occurrence) the attractiveness of liquidity will be increased. An event which increases focus-gain must, by the nature of y-curves, have been surprising. This means that a reshuffling of the entrepreneur's attitude must occur in such an investment-stimulating event. Such assimilation will take time; and this means that even for pleasant surprises, investment is likely to take place only after a time lag.

Investment-depressing events are immediate in their effects. If they are also "surprises", they are a fortiori discouraging to investment in concrete equipment.

With respect, then, to unexpected events Shackle concludes that their effects are time-wise asymmetrical. On the investment-stimulating side, only after a time lag is investment likely to take place. But the effects of investment-depressing events are likely to be immediate.

54 The card-gold example is not conclusive. Men do risk fortunes on the turn of a card; and when strategy, skill and chance are all involved as in poker (and business) the temptation may be greater than in risking a "cut from the deck." Cf. McDonald, John, Strategy in Poker, Business and War, New York: W. W. Norton, 1950.
From an indifference map of focus-outcomes, on which are given the standardized focus gains, and corresponding focus losses, of two investment opportunities one can read off which of two ventures will be preferred.

Indifference curves represent combinations of standardized focus-outcomes equally attractive to a person in given circumstances. The lines have positive slopes where \( g_o \) (focus-gain) is plotted vertically against increases in \( h_o \) (focus-loss) horizontally. Shackle terms these "gambler indifference curves." The one which passes through the origin is the origin indifference curve.

If a person decides what \( h_o \) and \( g_o \) are, for particular ventures, he can say that he prefers that which lies on a higher indifference curve. "By thus comparing in turn every pair of opportunities which can be formed from the entire list of rival opportunities which he has in mind, he can decide which is his most preferred course of action."

The origin indifference curve has empirical, but probably not important, meaning. If one asks an individual to name for various focus-losses, focus-gains such that these combinations are equivalent to experiencing neither gain nor loss, it is possible to plot a schedule of gambler preference. This schedule defines the "set of ratios of abscissa to ordinate of all points on the origin indifference curve." 56

Shackle has not performed any experimental tests of his theory. He contends that individuals are able to identify introspectively focus-outcomes, and that this assumption is sufficient for meaningful theorems. His analysis does result in the important qualitative inferences outlined above. And these qualitative conclusions can be given an empirical reference. Inquiry could be made of investors concerning how they would react to surprising events leading to focus-losses or gains and what

56 Ibid., p. 31. A complete set of indifference curves for any individual seems incapable of quantification. As measures of personality traits, schedules of gambler preference might be useful. Two persons might have exactly identical y-curves and equal focus-losses but the influence of their distaste for potential surprise might be such that for any point \((x,y)\), \(\frac{dy}{dx}\) would be equal while \(\frac{\partial^2 y}{\partial x\partial y}\) would be unequal. This would be reflected in the concavity of contour lines, a more cautious person would be represented by lines more concave to the \(x\)-axis. Personality tests of this nature would have a precarious foundation, even if measurement were possible.
time lag they envision between surprising events and further action. Past experience along these lines could be traced to validate these findings.

In this study, an effort will be made to note the time-wise effects of surprising events, both those which are "pleasant" and those which are "unpleasant," in the rubber industry. Some of the evidence in later chapters indicates that Shackle's conclusions have some validity.

It seems significant to note how similar Shackle's predictions are to those of Hart. The chief effect of being surprised, i.e., finding one's uncertainty increased through time, is the inhibition of investment activity even to a certain extent if the surprise is favorable.

F. Comparison of Hart and Shackle

A fundamental difference in Shackle's approach as compared with Hart's is his manner of interpreting subjective probability distributions. Modern theory of statistical inference is of limited use in describing entrepreneurial expectations according to Shackle. For

57 An operational definition of Shackle's standardized focus-gain might be the point in a firm's planning curve called the "break-even" point. This is the stage of production where, from the company's point of view, production might as well be zero. From the employees' and officers' points of view, this would not be true, of course. This concept does not appear to be capable of demonstrating reactions to uncertainty but it does illustrate the fact that the concepts proposed by Shackle are not alien to business planning.
example, reliability values of a subjective probability distribution of the future values of some non-recurring event are incapable of tabulation. The entrepreneur's inability to consider a proposed investment expenditure as one of a large number of recurring similar events vitiates the use of modern statistical inference, according to Shackle.58

Thus to consider that the expected value of the future course of an event can be defined as an additive feature of guesses weighted by probabilities is inadmissible. To consider changes in expectations as reactions to dispersion changes, is likewise inadmissible, strictly speaking, in Shackle's analysis. It is possible, as a matter of interest, to exhibit increasing dispersion of estimates as favorable to investment, contrary to Hart's thesis.59

58 This controversy is related to "the dispute between those who interpret probability as a measure of degree of belief (for example I. Fisher or Lord Keynes) and those who regard probability as a measure (objective) of relative frequency." Cf. Arrow, Kenneth J., "Alternative Approaches to the Theory of Choice in Risk-Taking Situations," Econometrica, Vol. 19, No. 4, October, 1951, p 410. Arrow notes also three recent developments in the theory of choice under uncertainty. One is the von Neumann-Morgenstern "axiomatic treatment of choice among probability distributions." Another is a product of modern statistical inference as it has been developed by Neyman, E. S. Pearson and A. Wald. A third alternative is Shackle's rejection of statistical concepts. A later section of this chapter will develop the relationship between the statistician's problem and the entrepreneur's situation.

59 Dispersion increases, for example, if the distribution is positively skewed.
The predictive statements on the effect of surprise in the analyses of Hart and Shackle are equivalent. The effect of surprise, even when agreeable, is to postpone investment in hard goods.

Shackle perhaps contributes more than Hart in terms of generalizing entrepreneurial impulses. He reduces them to reluctance from potential surprise and temptation from possible gain. He has a sensible position in being skeptical of concepts based on mathematical probability. His inferences from initial hypotheses about the entrepreneur's world view are operationally meaningfully - that is, one can think of experimental tests for them.

While Hart's probability approach is open to some question, his predictive statements are useful, operationally meaningful and exactly similar to Shackle's in some respects (for example, effect of surprise). His conclusions concerning the influence of unsettling information seem to be valid. Further, his unique contribution and an important one, is the description of specific entrepreneurial reactions in hedging against uncertainty and surprise - namely, flexibility in cash, inventories, insurance, and unspecialized equipment.

Neither Hart nor Shackle refer to new understanding of data, selective perception and more generalized psychological
realization, and their relation to investment behavior. This definition of expectation is derived from Shackle:

"By expectation I mean the act of creating imaginary situations, of associating them with named future dates, and of assigning to each of the hypotheses thus formed a place on a scale measuring the degree of belief that a specified course of action on our part will make this hypothesis come true."3

Our supposition is that differences in perception of investment opportunities are a significant factor in determining investment behavior. The investment situation is an ambiguous one, in which "correct" alternatives are not clearly marked. Since investors must act under varying degrees of information, objectively identical data may produce wide differences in investment action. These differences depend upon characteristics of individual firms, which may account for the distribution of investment activity at a given point in time. The clustering of investment activity at different points in time must be accounted for in terms of changing views of the meaning of investment opportunities.

If private investment in the American economy were small, this clustering of activity at various points in time might be disregarded, as might the changing qualitative nature of the activities at any one moment.4 However, investment


approaches to changes in expectations. Neither Hart nor Shackle answers the questions: What kinds of data are used in forming expectations? What selective operators distribute the data in expectational form? Or how expectational situations develop one out of another with the unfolding of experience? Shackle and Hart do not deal adequately with the view of behavior which pictures individuals constantly endeavoring to structure their cognitive fields with information always incomplete. Nor do they consider how strategical and deceptive actions enter entrepreneurial behavior.

G. Jacob Marschak

Marschak's approach is similar in several ways to Hart's. Writing in 1941, Marschak defined the "expected value" of a variable as the weighted average of expected future values of the variable, the weights being probabilities. "Confidence" was defined as a tendency to estimate a low dispersion of these values.

Recently Marschak has shown the importance of liquidity

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60 Katona, Psychological Analysis of Economic Behavior, and evidence in social psychology cited in Chapter One.


63 Ibid., p 53.
and dispersion of estimates in investment decisions. He relies heavily on models exhibiting results of certain behavioral and environmental assumptions. A summary of these follows, stated in their more general qualitative form.

First, the effect of liquidity considerations is to delay investment, even in non-stochastic cases with complete information.

For stochastic cases with complete information, initial investment increases with liquidity, and decreases with increasing variance of the random shift of the parametric changes in the revenue function. Optimum behavior for meeting this situation is a minimax strategy. The policy predictions, however, flowing from this analysis are similar to Hart's. Graphically:

Figure 2.8

Marschak's conclusions may now be stated in a form amenable

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65 McDonald, op. cit., pp 63-74.

to empirical verification. Liquidity tends to increase initial investment irrespective of certainty assumptions, and a decreasing dispersion of estimates through time further increases investment responses. Marschak's recommendation that a minimax strategy is synonymous with optimum policy for facing uncertainty, however, raises the question of the definition of such behavior.

H. Minimax

In simple games of strategy, participants face similar problems. For example, in matching pennies, while players initially face no chance elements, they have imperfect information about their opponent's moves. How should a "good" player behave? If he follows a definite policy pattern, there is a possibility that he will be found out, and defeated, even though there is a possibility also (not a good one) that he will hit on a pattern capable of destroying his opponent. A "good" player introduces,

Friedman criticizes this approach by saying that uncertainty is not the essence of the problem discussed by Marschak. The problem is merely the familiar one of common cost where the price of an asset in one period is greater if a smaller quantity of its complement is used in the second period. There exists for the uncertain cost in the second period an expected function equivalent to the "uncertain" one, according to Friedman. This is, however, merely a certainty equivalence, and is devoid of new meaning (as is Weintraub's) except as it might be pushed toward Shackle's focus-outcome which is also quite similar to a certainty equivalent. See Friedman, Milton, "Liquidity and Uncertainty - Discussion," American Economic Review, Vol. 39, No. 3, May, 1949, pp 196-199.
therefore, some random element into his plays, for example flipping the coin. His opponent cannot predict better than chance what each move will be under this strategy. If the opponent follows the same chance strategy, the two will break even (within the standard error of the number of trials). This is a zero-sum game.68

In poker, on the other hand, chance, incomplete information, choice (opportunity for deception) and interdependence all combine to make for an ideal strategical situation. There the core of the problem is "how can a player guarantee himself a certain minimum return, regardless of the other player's action?"69 The optimum strategy then requires this assumption: "That the player assume in advance that he is found out." The specific moves that occur under such a strategy must be randomized. Thus, if the worst happens (player is found out) the player's opponent still cannot know how any specific move will turn out since these results are random.

Optimum strategy according to minimax rules does not lead to a "maximum maximum" return. Neither does it lead to the worst result. It leads to some middle outcome, or in a two person zero-sum game to no-net gain.

68 A common method of matching pennies includes the rule that both parties shall "flip" the pennies. This required randomization eliminates gambling if the game is played for a long time.
69 McDonald, op. cit., p 63.
Minimax solutions have one thing in common with Shackle's approach. The actor will not choose the path leading to the most extreme reward. Shackle's players lack a unique over-all strategical approach. Ideas of reward, disgrace, and surprise compete for supremacy and no one of them wins. It seems likely that in the many-person uncertain-sum games in which most entrepreneurs play, Shackle presents a theory more adequate for empirical investigation.

One should also note that under Hart's formula for maximization, the entrepreneur does not play to receive the most he could receive if his "hunches" were correct, but to get the most possible in the light of chronically inadequate information. 70

A minimax solution provides us only with the rather unsurprising qualitative prediction that a rational rule of action is to leap somewhere between the best and the worst appearing alternatives. That is, it asserts that it is a wise course of action to risk faring somewhat worse than one would under the least disadvantageous situation that could occur in order to improve one's position if the best situation

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70 This is consistent with the "principle of increasing risk" formulated by Kalecki. Kalecki argues that as investment increases, the proportional equity of the "owner" is likely to decrease. This will make the "owner's" position more vulnerable in the event of loss. See Kalecki, Michal, Essays in the Theory of Economic Fluctuations, New York: Farrar and Rinehart, Inc., 1939, pp 95-106.
materializes. Conversely, the very best outcome is ignored in order to improve one's position if the worst does happen.

Modigliani illustrates this with an interesting imaginary case. A dealer has exclusive rights to sell hamburgers at an airshow at which the main attraction is the "expected arrival of a man flying a very dangerous machine across the Atlantic." The man may have an accident and attendance will fall off, likewise sales.

Outcome and regret curves may be drawn as follows, where regret equals the best possible outcome minus actual outcome.

Figure 2.9

The maximum maximum that the entrepreneur could attain would be output \( x_2 \). But this is associated with a large potential regret. Further, the least regret point would be \( x_1 \), but possible profits at this point would be small. What the dealer ought to do for an optimal (minimax) solution is to choose the minimum of the greatest possible regrets for

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each output. This is point \( x_r \), the minimum point of the curve composed of the lower output portion of the no-accident regret curve and the upper output portion of the accident regret curve.

A recently formulated investment plan has the requirements of a minimax strategy although it was not labeled such. This plan is called "formula plan investing" and is a scheme for changing bond–stock ratios in investment portfolios in such a way that stocks will be purchased sometime when they are "undervalued" and sold sometime when they are "overvalued."  

Whether this plan is mathematically equivalent to minimizing regret is not clear. However, its consequences seem to be equivalent. The plan works as follows. Sometime after the Dow–Jones average crosses some previously worked out trend line for stocks, the ratio of bonds to stocks is increased by a previously specified amount. The exact timing and ratios depend upon the particular needs and attitudes of the investor. The result is to obtain not the maximum that could be derived from perfectly predicting the timing of "bear" and "bull" markets but is some intermediate amount. The effect, that is, on bond–stock ratios is that

increasing the ratio as stock prices rise and decreasing them as stocks fall if a variable ratio is employed.

The effect on gain is that of obtaining an intermediate gain if no catastrophic or episodic events upset the stock market. The decision maker employs a formula which thus has the attribute of choosing for him actions which minimize the maximum "regret" within the limits set by his own peculiar aversion for risk or his own need for action.

In the realm of applied economics there might be several applications open to minimax strategy. For example, many money theorists argue that the Federal Reserve System should support United States Securities but the prices should be flexible. Specifically then a minimax strategy suggests that a random movement of support prices, within limits, would be the Federal Reserve's best policy.

Another application might be in the realm of farm support prices. Schultz and others have argued that farm price supports should be more flexible. The possibility of randomizing support prices, again with limits, might be investigated as optimum (in this case minimax) policy.

The minimax approach is in an early stage of development. It merely suggests a rule of action descriptive of behavior under uncertainty, and is recorded here as one possible approach.
The minimax approach is designed to help the firm (or individual) avoid a disaster outcome. However, in the area of experience outside the "game" situation, episodic events and "runs" of bad luck may create a catastrophe. For this reason, firms must take account of the possibility of a disaster.

I. Safety First

Basic to many aspects of our experience is the possibility of a catastrophe. One writer has noted that "in practice, death, bankruptcy, and a prison sentence are likely to be associated with sharp breaks in both our pattern of behavior and in our scale of preferences."73

Of course there must be individual differences in the level of income, say, constituting a disaster situation. But that a disaster level of income (or the lack of income) exists for most firms seems a priori evident. And a fortiori it seems evident that firms will give priority in their plans and actions to measures calculated to avoid the occurrence of a disaster.

Hart recognized this type of motivation. His emphasis on entrepreneurial concern for flexibility is perhaps an adequate account of disaster-conscious behavior. His descrip-

tion of the business man's "craving" for liquidity and
insurance is a recognition of a firm's fear of catastrophe.
Likewise, Hart's "linkage-of-risks" is a statement of the
possibility that an awful end may result from an initial
small misfortune.\footnote{74}

Roy recently attempted to outline optimum behavior
patterns for a firm interested in avoiding a catastrophe.
Assuming the firm knows the expected outcome, say \( m \),
and its standard error (\( \sigma \)), the qualitative conclusions
reached by Roy are that dispersion of assets is the best
method of avoiding a "constant level" disaster and that
small changes in expectations about price may lead to
large changes in demand for assets or liabilities.\footnote{76}

In a recent study of optimum livestock feeding policy
with special reference to uncertainty, Olsen found that it
was helpful to compare mean return with the historical
variance of such a return and the maximum loss \((-2\sigma)\)
associated with such a return. These criteria correspond

\footnote{74} Hart, A. G., Money, Debt and Economic Activity, New York:
Prentice-Hall, 1948, pp 199-200. In his example, a jail
sentence results from a motorist's inability to meet the
consequences of a flat tire. Such phenomena were
recognized by Maupassant in his short stories as early
as the 1880's, although they were given a perhaps more
subtle and basically philosophical meaning. Cf.
Guy de Maupassant, La Ficelle. On this score, see also
Modigliani's statement that "the decision problem of the
firm at any point in time is that of choosing an optimal

\footnote{75} A disaster level independent of the size of the stakes.
\footnote{76} Roy, \textit{loc cit.}, p 434.
expenditures are extremely important in the American economy, in terms of the trade cycle and in terms of capital accumulation.

B. Volatility of Investment Expenditures and the Trade Cycle

The volatility of investment expenditures is a widely accepted fact. Elementary texts alone adequately document the sensitivity of investment action. Extreme fluctuations in investment activity play an important part in business fluctuations.

Early in this century, John Maurice Clark described the role of investment activity in the business cycle. In journal articles and books, Clark attributed many of the production, price, and income problems of modern economies to the prominence of "overhead costs." Overhead costs have many facets, and their economic implications are complex. Some writers have noted that overhead costs have created in industry a disproportionate attention to machines as compared with men. What merits attention here, however, is the "acceleration principle."

This principle refers to the extreme behavior of investment expenditures as they respond to the stimulus of increased consumer spending. The explanation of these extreme responses to changes in consumption spending lies in the large productive capacity of modern machines, their long life, and high money cost. A small percentage change in the number of consumption goods
closely to Roy's theoretical concepts. In his empirical work, Olsen found that generally no unique best choice existed because where mean return was higher, variance and maximum loss were likely to be higher. The course of action in these cases would depend upon the individual entrepreneur's aversion for risk.77

Schickele has pointed out the fact that for farmers in the Great Plains area, where weather conditions are very uncertain, survival comes first and maximization of income second. He suggests that one solution to their problem of "runs" of unfavorable crop years is diversification.78

Heady has recently shown, however, that the problem of the direction of diversification is an important one. If the entrepreneur chooses products whose variances are positively correlated through time, his problem is merely intensified. The ideal diversification involves the selection of products whose income variances are exactly inversely correlated.79 As will be shown in later chapters, rubber firms have become increasingly


diversified. This is partly an uncertainty reaction. Firestone's biographer phrased this in an interesting way, for example, when he commented on the problem of changing to war production in the early 1940's while maintaining civilian markets.

"In the realm of retailing and serving the home front, the principle of diversification proved a source of strength. Dealers as well as company stores were enabled to adapt themselves to war-time conditions and thereby survive. As in 1940, when the company made available such merchandise as housewares, farm equipment, and plumbing supplies for better-balanced sales, so in 1941 gas and electric ranges, refrigerators, washing machines, luggage and sporting goods, and in 1942 work clothing, glassware, dinnerware, paints, and phonograph records were added."80

Certainly survival itself is an important part of a firm's plans for meeting an uncertain future.

For the stochastic case (random variable or variables) with incomplete information, probably no theory is completely adequate. Marschak notes that the problem is identical with the theory of statistical inference viewed as a "theory of choice of action rather than a choice of hypotheses."81 This emphasizes the importance of sequential analysis, to which the next section will be devoted.

J. Statistical and Entrepreneurial Decision Functions

The entrepreneur, like the statistician, faces what is essentially a sequential choice.\textsuperscript{82} With respect to inventory or capital equipment he must decide on a point where the cost (in terms of "foregone profits") is greater than the probability of loss from changing liquid resources to illiquid form.\textsuperscript{83}

Where the decision maker faces a situation equivalent to a game against Nature, a decision procedure which "minimizes the maximum" risk is suggested by Wald.\textsuperscript{84} This will ensure that the final result will be independent of Nature, that is, the actor will be if not "master of his fate" at least "captain of his soul." For a statistical problem Wald has developed a sequential probability ratio test which is useful in finding the optimum point at which sampling should be terminated.

It is not at all clear to the writer that entrepreneurs face forces equivalent to "natural" ones in their investment decisions or that the entrepreneur's situation is analogous.


\textsuperscript{83} Ibid., p 215.

\textsuperscript{84} Cf. Wald, Abraham, Sequential Analysis, New York: John Wiley and Sons, 1947.
to that of the statistician. However, it is clear that the history of statistical inference during this century has proceeded finally to the question of deciding when further action is profitable. At the present time various varieties of "minimax" solutions are the main carry-over from statistical to entrepreneurial decision functions. However, the sequential choice situation is basically the one facing the entrepreneur.

In this area, modern communication theory is suggestive of a useful method of diagramming an entrepreneur's reactions to investment information. Certain types of communication theory describe that portion of the information useful for predictive purposes as "redundant." For example, if circles x and y represent sequential information, then the overlap is "redundant."

Figure 2.10

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85 From the Pearsonian stage, statistical inference has gone through a Fisherian stage, and a more or less current Neyman-Pearson and Waldian stage. See Hodges, Joseph L., Jr., Discriminatory Analysis, Survey of Discriminatory Analysis, Randolph Field, Texas: USAF School of Aviation Medicine, Project Number 21-49-00H, Report Number One, October, 1950, pp 2-3.

To the extent that redundancy of information increases, the entrepreneur will feel confident in his predictive efficiency, and in cases where experimental evidence is available in simpler situations, individuals do become more efficient predictors as "redundant" information increases.

An empirical investigation of entrepreneurial decision making should include a study of the extent to which "redundancy" reduces the number of alternatives open to the actor so as to produce an investment response.

In the main, description of entrepreneurial decisions will depend on the "coding" used and this varies with the problem at hand. However, an empirical study should note some relationship between "redundancy" and investment action.

The human being, according to Miller, is an extremely inefficient handler of information. A considerable amount of information is necessary to enable him to make accurate predictions. And even then he may make the prediction too late. (This is not inconsistent with the "flurry" of investment activity in which rubber firms engaged during 1928-29.) What finally "triggers off" predictions or action is a difficult question to which perhaps only a qualitative answer is possible. However, sequential analysis and communication theory constitute a convincing model against which analysis of entrepreneurial behavior becomes more understandable and perhaps convincing.
Chapter III

EMPIRICAL AND PSYCHOLOGICAL EVIDENCE

A. Resume

Thus far we have not considered the literature relating to the more specific factors which enter into investment decisions. Most of the discussion in Chapter Two referred to attempts at model building. In this chapter attention will be given to the experiential and institutional factors affecting and affected by anticipations, and to the relevance of more generalized behavioral studies to the formation of expectations.

This is a point in our survey, then, when previous arguments should be drawn together in preparation for a new departure.

First, the functional interdependence characteristic of the various elements of an economy was noted. Questions were then raised on the following two points. How are adjustments made among elements of the economic population of firms? How does the individual firm adjust and what chains of reactions arise from such adjustments? The important question for this study is the one concerning the manner in which a firm views its situation in the economy.
The first question involves a complex answer. "Representative firms, taking account of the interest rate and profit possibilities, adjust minimum cost (at the proper scale of operations) exactly to price. Variable costs may constitute a hedge against change even under conditions of subjective certainty. Under conditions of uncertainty, the problem of change may reduce to that of price determination under joint cost, if certainty equivalents are accepted as adequate explanatory concepts.

Dynamic aspects may, however, be introduced by considering total demand and supply functions, expectance horizons, and lagged adjustments of supply to demand (cobweb, and other). Further, as with Roos, equations describing the economy may include rates of change of certain variables (for example, price, income, and sales).

Closely related to this step, the answer to the second question consists in describing reactions to uncertainty. Hart lays great stress on the maintenance of flexibility and presents a theory of the formation, change, and clarification of individual expectations. Hart, Shackle, Tintner, and Marschak represent model building authors along these lines. A minimax solution, in various forms, was described as ideal
behavior for meeting uncertainty and much emphasis was placed on the asymmetrical nature of investment responses. Attention was also given to the nature of plans designed to avoid a catastrophe, where it was emphasized that diversification and attention to minimum survival needs were particularly important. Finally, the entrepreneur's problem was compared to that of the statistician where the basic question concerns the profitability of further action (in the case of the statistician, further sampling).

Of particular importance for business cycle theory is the description of inter-unit relations. Compatibility or incompatibility of plans and trends in expectations are extremely important. This thesis is not concerned directly with such a problem. Nevertheless, business cycle theory is indirectly important here because trends in average expectations may influence expectations of the individual. In the Appendix to this chapter an account is given of the way in which Hart, Angell, Shackle, Hicks, and Katona analyze the important question of trends in expectations, and their relation to the business cycle.

B. Katona and Terborgh

Katona's work serves as a convenient starting point for
the examination of an institutional approach. Concurrently an
examination will be made of Terborgh's work.

Katona argues that investment decisions may be habitual,
or non-habitual stemming from a new cognition of the invest­
ment field. Replacement policy offers numerous examples of
the contrast between these types of action.

Depreciation practice on capital equipment may call for
an automatic replacement. However, there is evidence that
replacing a machine not completely written off is a "difficult
decision." Terborgh speaks of a "vague feeling that capital
assets ought to be kept in commission over the service life
assumed for depreciation purposes." Where there must be a
decision reached involving the abandonment of a machine prior
to its being written off, a new cognition of the situation must
occur with the entrepreneur.

Other rules of thumb make for somewhat automatic decisions.
For example, if liquid funds are available, and if the re­
placement appears to have a short pay-off, the decision to
replace equipment is an easy one.

According to Katona, rules of thumb for investment contrast
with genuine decisions. Genuine decisions are a result of

1 Terborgh, George, Dynamic Equipment Policy, New York: McGraw­
Hill Book Company, 1949, p 245.
2 Ibid., p 5.
3 Katona, George, Psychological Analysis of Economic Behavior,
predicting a changed situation. Katona hypothesizes that the general economic outlook of business men has much to do with their perception of investment opportunities and that radical changes in business men's outlook for the future are infrequent.¹

Some of the questions raised by Katona are relevant to this study. They are, in part cited below.

1. Are expectations and plans definite, written, detailed, or are they matters of general feelings or hunches?
2. Who makes decisions and what information is used? How much prior research? Are "capital budgets" used?
3. What is the role of liquid funds? Role of interest?
4. How many decisions were forced decisions?
5. What is the role of existing versus expected conditions as factors in formation of expectations?

Chapter Seven contains some interview material relevant to these questions.

Terborgh's theory of equipment policy deals with some important aspects of investment decisions.² It will be argued that the question of adaptation to uncertainty is not adequately analyzed there; but his theory is a significant contribution. Terborgh first notes the undue attention which business

¹ He argues that most business people are likely to change their views at about the same time also. See his article "Psychological Analysis of Business Decisions and Expectations," American Economic Review, Vol. 36, No. 1, March, 1946, pp 44-62.
² Terborgh, op. cit.,
taken leads to a small absolute number of new machines. However, the percentage change in capital equipment and investment expenditures thus brought about is quite large. \(^5\) "The tendency," said Clark, toward "intensified fluctuations of derived demand, including . . . durable consumers' goods as well as producers' goods, is of basic importance." \(^6\) Clark recommended that firms budget capital outlays on plant and equipment through several years in order to lessen the effects of the business cycle. Such budgeting might be accomplished, Clark thought, by planning of a voluntary nature on the national level.

In a more recent analysis, J. R. Hicks has outlined sharply the importance of investment expenditures. \(^7\) Synthesizing material on the accelerator and multiplier, Hicks arrives at a comprehensive theory of the business cycle which places major emphasis on "induced investment." "Induced investment" in real (non-monetary) terms is the investment category basic to a study of expectations. A review of this problem and the work

\(^5\) Cf. Clark, J. M., Studies in the Economics of Overhead Costs, Chicago: University of Chicago Press, 1923, pp 389-396. The mathematical expression for the accelerator is that investment expenditures are linearly related to the rate of change, or first derivative, of consumer demand. Symbolically, \( I = \frac{dC}{dt} \).


\(^7\) Hicks, J. R., A Contribution to the Theory of the Trade Cycle, Oxford University Press, 1950.
men place on short pay-off periods, depreciation accruals, and availability of funds.

These practices cannot be reconciled with a rational approach to reequipment policy, according to Terborgh. He argues that replacement decisions should turn on a proper recognition of deterioration, obsolescence, and finance capital cost of alternative equipment. As a rule, Terborgh contends, present replacements are made on the basis of accounting records which are of historical, and not predictive, value. Or they are made with an eye to a quick pay-off or arbitrary rate of return. What investors should concern themselves with is a replacement formula adequate to evaluate the alternatives resulting from 1) a succession of equipment headed by existing facilities (the "defender") or 2) a succession of equipment headed by the best replacement ("challenger").

Such a replacement formula should minimize the discounted

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3 Data on several hundred firms, representing an unspecified population, indicate that two-thirds of the firms require replacements to be paid out in three years or less. Terborgh, op. cit., pp 190-92. Also see Dean, Joel, Managerial Economics, on the importance of a short pay-off.

Terborgh notes that over 100 out of 120 firms questioned by the Machinery and Allied Products Institute believed that their customers' liquid position was "determining or important" in decisions to buy or not to buy. Cf. also Rautenstrauch and Villers, Budgetary Control, New York: Funk & Wagnalls Company, 1950, p 225.

The importance of depreciation accruals has been noted. Terborgh speaks of a "vague feeling" that assets ought to be written off before being replaced. Katona emphasizes considerations of this kind making for automatic, instead of genuine, decisions.
costs of equipment arising out of 1) finance capital cost and 2) obsolescence. This minimum Terborgh calls an "adverse minimum," and sound replacement policy involves the selection of equipment with the lowest adverse minimum.

Discounted capital cost is a decreasing, and obsolescence an increasing, function of time. If obsolescence is assumed to be linear, succeeding equipment opportunities "have the same adverse minimum as the present one" so that adverse minima can be found for any equipment choice without having to peer too far into the future. Further, if simple averages of capital cost and obsolescence cost replace time adjusted ones (and if salvage costs and capital additions are negligible) then a very simple formula yields specific figures for such adverse minima.

This facilitates actual choices to the extent that a general rule for rational action is available. Obviously there is room for judgment, but merely by discounting properly 1) capital cost and 2) rate of obsolescence, of existing and challenging equipment, the best replacement decisions are susceptible of simple statement.

Experience judgment is necessary in estimating the rate of.

7 Terborgh, op. cit., p 76.
8 At least one large oil firm apparently computes for alternative proposed projects their discounted future receipts.
obsolescence. This rate is always relative to the job which
the equipment performs. But a first approximation may be
obtained by finding the monetary inferiority of present equipment
relative to proposed equipment and dividing, then, the result by
present age of existing equipment. Further judgment is required
in estimating salvage value, probable capital additions to
equipment, and the proper discount rate. In particular, managers
should view the interest rate as that cost of money which
maximizes profits, according to Terborgh, irrespective of
financial position or fondness for one's own enterprise.9

Significantly, the selection of such an interest rate
permits the executive to beg the question of uncertainty.
Since the present worth of a future income becomes smaller
and smaller as the future extends further from the present,
only consequences of replacement in the "reasonably near future"
need concern the analyst. This is an instance of certainty
equivalence. Terborgh's abstraction from uncertainty questions
leads him to condemn current practice relative to rate of re-
turn and (particularly) short pay-offs. 10 These practices, in
the light of his theory, are seriously too conservative.11

The short pay-off requirement "betokens a stodgy conservatism"

9 Terborgh, op. cit., p 175.
10 Katona, it will be recalled, merely notes the difference be-
tween a decision based on a rule of thumb and one based on
new understanding of a situation.
and "is a barrier . . . to the replacement of equipment." Similarly, this judgment applies to arbitrarily high rates of return requirements.

Available evidence, meager as it is, suggests that the short pay-off and the availability of liquid funds are dominant, if not controlling, factors in replacement decisions. Yet Terborgh presents an extremely well-argued case that this is not maximizing behavior, particularly since it overlooks "opportunity costs." A prima facie conclusion, to the writer, is that uncertainty considerations are overriding in most investment decisions.

For no matter how attractive the policies based on assumptions of linearity and continuity in obsolescence and capital cost functions, entrepreneurs know from experience that future markets are uncertain. Liquid funds may be much more important "tomorrow" than "today." The importance of flexibility, of waiting for more information, is not expressed by the simple assumptions in Terborgh's analysis.

Terborgh wisely asserts that the first rule of replacement is to "remember Lot's wife." Such admonition is satisfactory for the linear technological progress and compound interest of Terborgh's analysis, but not completely adequate for an uncertain world.
Terborgh's analysis is a subtle, well-stated point of view with which replacement analysts should familiarize themselves. Evidence indicates that too few firms give systematic attention to their replacement problems. Many ideas originate in the production line which may not be given proper appraisal by top management. It seems doubtful that replacement analysis should stop with Terborgh's procedure; for as Terborgh says it is mainly a "reasonable framework of projection where the future is not specifically predictable." It appears to be a valid maximizing formula where national income fluctuations are not severe. This in the past has been, however, a somewhat special case in the functioning of free economies.

C. The Social Psychologists

In the first chapter reference was made to the relevance of social psychology to expectations and investment. There it was pointed out that a major assertion of current social psychology is that even in the most ambiguous (for example, random answer) situations, individuals tend to structure their experience around a few simple factors. This is the first conclusion important for this study.

12 "The perceptual and cognitive field in its natural state is organized and meaningful." Krech and Crutchfield, Social Psychology, New York: McGraw-Hill Book Company, 1948, and other general works in social psychology. Experience is never, that is, a "blooming, buzzing, confusion." Michote, a French psychologist, has shown that events are perceived as causal if they are proximate and similar.
Second, there is evidence that answers meaningful in one context tend to be borrowed for another. Rubberizing, if not a complete, is at least a suggestive description of behavior in ambiguous situations. Answers to rather abstract problems may be borrowed from differences along other, more concrete, dimensions. By the halo principle we refer to differences along one dimension spreading to influence perception along other dimensions.

Not only is there a non-Euclidean economics (and geometry, where it is more correct to use such a term) but a non-Euclidean or Gestalt view of perception in psychology. The total view of a situation may be different from the sum of observations that would be made if the several aspects of the situation were viewed separately. Thus the total view of the entrepreneur is important. His understanding of one or two variables, like sales, inventories or profits, and their rates of change will vary depending upon the total situation.

Anthropologists have emphasized for a considerable time the importance of culture-given answers to life situations, and the virtual elimination of certain choice points. This suggests

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14 For a general account of the Gestalt theory see Köhler, Wolfgang, *Boni & Liveright*, 1929. Note particularly his reference to "the original organization and segregation of circumscribed wholes which make it possible for the sensory world to appear so utterly imbued with meaning to the adult," p 208.
that the common experience of the business cycle in our culture may influence all its members to predict such occurrences no matter what their own sales forecasts appear to be.

What is the net contribution of the discipline of social psychology to the problem under consideration?

First, there is support for the general hypothesis that expectations are not unordered and unique for each instant in time.

Second, certain instruments in attitude and opinion measurement give us technical assistance in evaluating expectations. These will be mentioned and used as necessary.¹⁵

Third, certain clues about structuring of experience and perceptual selectors are evident from this general approach to behavior. They are enumerated below.

1. Selective factors are likely to be simple.
2. They will be relative judgments but thought of in absolute terms.
3. They will be strongly held relative to the lack of reliable information.
4. Answers from one experience will tend to be carried over to another.
5. The total view of a situation, for example, the business outlook, will be important as a culture-given answer.

¹⁵ Krech and Grutchfield, op. cit., pp 149-315.
6. The tendency to make decisions on the basis of existing conditions rather than predicted conditions will be strong.

7. Causal factors will be perceived as those proximate and similar to the end result.

8. Perception of reward will depend upon "psychological" rather than "objective" values, for example psychological value of the prize, psychological value of the price paid for the prize. Perception of the probabilities will be different from mathematical probabilities.¹⁶

9. Short-term considerations may be critical factors in long-run decisions. As Keynes intimated, short-term expectations may be the "tail," which wags the "dog" of long-term expectations.

Illustrations from the rubber industry will be noted in succeeding chapters.

D. Empirical Studies

A promising study was initiated at the University of Illinois under the direction of Franco Modigliani on "Expectations and Business Fluctuations."¹⁷ It relates ultimately to inter-firm plans but is concerned initially with origin and clarification of expectations. An attempt is made to investigate "The state


¹⁷ Modigliani, Franco, "Expectations and Business Fluctuations" A Joint Research Project of the University of Illinois and the National Opinion Research Center, University of Chicago, sponsored by the Merrill Foundation for the Advancement of Financial Knowledge, Mimeographed Progress Reports, hereafter referred to as the Merrill Project.
of economic expectations, its origin and laws of change in relation to the process of investment in plant and equipment."

Modigliani notes that empirical work is needed to relate the theory of investment decisions under uncertainty to actual behavior. In particular, investigation is needed concerning capital rationing, equipment replacement and ignorance of probability distributions of planning parameters.

Basically investment behavior, according to Modigliani, depends upon technological, financial, and expectational considerations. Analysis of expectations should not omit reference to technological and financial considerations which in the real world cannot be separated from expectational ones.

Relative to inter-firm plans, their compatibility and role in the business cycle, certain hypotheses are suggested:

1. If expectations are concentrated closely about some central tendency, then the relation of expectations to business cycles should be clearly definable (that is, and shifts in average expectations should be independent of changes in business if expectations actually are a major factor in business cycles).

2. Uniformity of expectations refers to concurrence of judgment with regard to general rather than each firm's own business conditions.

3. Expectations depend on the rate of change of variables, for example National Income, or past profits.


19 Ibid., p 8.
Studies of the relation of expectations to investment, Modigliani suggests, ought also to include information on the extent of formal planning. In this regard a perceptive suggestion offered by Modigliani is that budgets be obtained and compared with realized investment and other variables. This constitutes what might appear to be an effective operational link between ex post and ex ante data. Such information would need to be supplemented with interviews, records of opinions of industry or firm spokesmen and so on. The writer tried, as a matter of fact, to apply this technique in the present study. The experience in this study indicates that the budget technique has several limitations.

First, firms are reluctant to disclose significant data to an individual outside their organization. Second, few really valuable records exist with respect to the arguments advanced for approval or cancellation of projects. Firms are more interested in the future than in the past. Third, selective awareness of past events tends to make for a distorted interpretation of existing records.

Nevertheless, an examination of requests for executive approval of expansion projects seems certainly likely to be worthwhile if the data were to be made available.