

PRICE THEORY
FOR A
CHANGING ECONOMY

BY
MOSES ABRAMOVITZ

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF DOCTOR OF PHILOSOPHY
IN THE
FACULTY OF POLITICAL SCIENCE
COLUMBIA UNIVERSITY

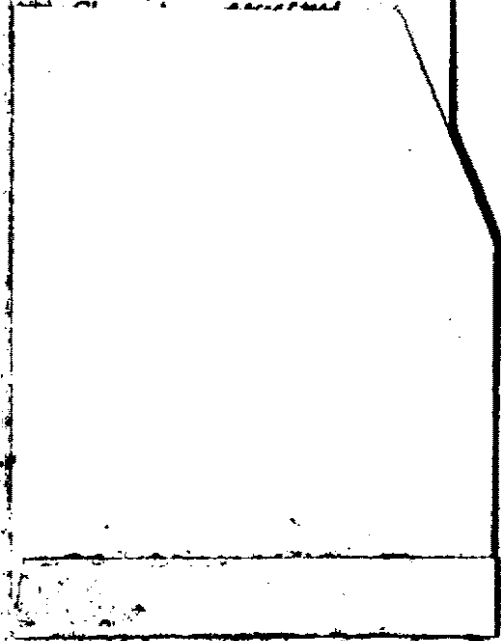
X:76
G9
14148

NEW YORK
1939

14148

Abramowitz, M.

Piece theory for a



**SERVANTS OF INDIA SOCIETY'S LIBRARY,
POONA 4**

Cl. No.

Date of release for loan

Ac. No. 14148

This book should be returned on or before the date last mentioned below.

Failure to comply will involve cancellation of the Borrower's Card and forfeiture of deposit.

11 DEC 1962

A. B. P. P.]

AN APPROACH TO A
PRICE THEORY
FOR A
CHANGING ECONOMY

Dhananjayrao Gadgil Library



GIPE-PUNE-014148

BY

MOSES ABRAMOVITZ

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF DOCTOR OF PHILOSOPHY
IN THE
FACULTY OF POLITICAL SCIENCE
COLUMBIA UNIVERSITY

NUMBER 453

NEW YORK

1939

X:76
G9
14148

COPYRIGHT, 1939

BY

COLUMBIA UNIVERSITY PRESS

PRINTED IN THE UNITED STATES OF AMERICA

PREFACE

ALTHOUGH this is an essay in the "pure" theory of "pure" competition, it began as an empirical study of monopolistic markets. It was the writer's belief that a study of prices and price policies in capital goods industries would help to extend the insights suggested by the theorists of monopolistic competition. The chief questions with which the data were approached were: what are the relations in these markets between prices and marginal costs and why do they have such relations? No direct measurement was attempted but reliable indirect evidence was sought.

The questions proposed were, of course, only too natural to one who had drunk so steadily at the neo-classical well. But whatever the importance of the questions, they proved, as in retrospect it appears they had to prove, a tactical mistake for the program of study in hand. An empirical study could throw only the most oblique and faint light on marginal costs and the state of demand, and even less on businessmen's notions of these conditions. The relations which are so important in their bearing on judgments of economic efficiency and public policy led to a *cul de sac* when used as the organizing concepts in an empirical study.

Continued study of the material did, however, yield a notion which bore development in a reconsideration of the theory. One of the obstacles in the way of reconciling the theory and the "facts" seemed to lie in a critical lack of generality in the assumptions on which the neo-classical hypothesis was based. The theorists of monopolistic competition secured their results by asking what was the most reasonable way of businessmen to act when conditions of demand and cost are stable. In such conditions one may well expect that prices would be substantially those which an independent monopolist would set. But one of the most pronounced characteristics of business is change in these conditions. The pursuit of this line of thought led the

writer to what he believed was a useful supplement to the theory of monopolistic competition.

Observation suggests that, in many industries whose main features are those of oligopolies, firms choose the tactics of competitive aggression not those of monopolistic cooperation. Competitive campaigns to extend one's share of the market for a more or less long time; undercutting to secure a temporary advantage are policies which are not consistent with sensible behavior in a stationary state. They are only to be thought of as aberrations from normal action. But in certain conditions of change such tactics appear sensible; they appeal to us as policies which we can expect of ordinary people. In that sense, the policies are explained. And price theory becomes more useful, because it comprehends without qualification a larger range of phenomena.

If stationary state theory presents a distorted picture of the results of normal monopolistic behavior, what of the theory of pure competition? Do the normal relations between price and cost there depicted furnish a useful summation of tendencies in conditions of change? Is it valid to say that in changing conditions, there is a constant tendency for price and marginal cost to become equal?

An answer to this question is not alone important for the theory of pure competition itself in so far as this theory offers a useful description of events in certain industries; it is relevant also to the theory of monopolistic industries because pure competition is generally held to yield results which are preferable to the hypothetical outcome of production and exchange in monopolistic conditions. Again if the critical investigation thus suggested should yield results different from those of the stationary state theory of pure competition, a good part of these results would have general application. If there be a tendency to overinvestment in competitive industries because the effect on price of an anticipated change in demand is overestimated, it is at least plausible *prima facie* that there will be a similar tendency in a monopolistic industry under similar con-

ditions. Finally, if the relevancy of the stationary state theory of pure competition to a changing economy is doubtful, this suggests the necessity for a framework of theory broad enough to cover both changing and unchanging situations. And if one could construct such a framework it would be an extension of neo-classical price theory which would be applicable to competitive and monopolistic conditions alike.

It is from these notions that this essay sets out to deal first with a critical survey of stationary state price theory and then to propose a framework of theory relevant to changing conditions. In the outcome, it is worth noting, the difficulty which turned the writer into these trails still remains. To make an empirical study of prices which will be pertinent to policy involves the student in a near-dilemma. One horn of the "dilemma" is that the statistical evidence leads to propositions which have but vague normative reference. Such propositions offer the possibility of test and improvement, but their significance is not apparent. The other horn—which this essay finally grasped—is the largely abstract reasoning of neo-classical theory. Research of this character carries with it a body of welfare theory which appears adequate for many, though far from all problems. But as a set of working hypotheses descriptive of the behavior of business, it is bound by serious limitations. The categories in terms of which it is built have no close statistical counterparts. As a result, the prospect that its propositions will be brought to test and developed is, to say the least, uncertain. This contribution, like other examples of the same species of price theory, is subject to these limitations.

In this difficulty—which is not quite a dilemma because one need not make firm and unyielding choices—one may yet hold preferences. Having completed this experiment in the development of hypothesis by a method so nearly that of immanent criticism, the writer finds himself drawn strongly toward the horn of empiricism. Two considerations weigh heavily. One is that the neo-classical Theory of Welfare no longer seems the universal touchstone of policy that once it did. So long as

unemployment remains our most crucial problem, it will hardly be adequate to assess the behavior of competitive and monopolistic markets principally by a criterion appropriate to the most efficient allocation of a given quantity of resources. Even more important, is the doubt which the writer entertains about the prospects for test and development so long as our hypotheses are not hypotheses about objective records. But this is itself a matter which cannot be brought to test. And if it seemed more than a matter of serious doubt, this essay would not be published.

The author is indebted for much to Professor John Maurice Clark whose writings and lectures in economic "dynamics" are responsible in part for this work. It ought perhaps be added that this responsibility is of the blameless, cause-and-effect, not of the moral, variety. He read the manuscript at several stages and effected its improvement at many points. The author is grateful also to Professor Arthur R. Burns of Columbia University, Professor Edward S. Mason of Harvard University and Mr. Milton Friedman who read all or parts of the manuscript and whose critical suggestions have left their marks throughout. To Carrie Glasser Abramovitz, Eli Ginzberg and Milton Friedman, the author wishes to record a special debt both scientific and personal not adequately to be described.

MOSES ABRAMOVITZ

NEW YORK, DECEMBER, 1938.

TABLE OF CONTENTS

CHAPTER I

THE PROBLEM POSED

	PAGE
1. Introduction	11
2. A General View of Neo-Classical Price Theory	12
3. Abstraction and Equilibrium in Stationary State Theory	16

CHAPTER II

THE RELEVANCE OF STATIC THEORY TO A CHANGING ENVIRONMENT

1. The Process of Adjustment to Equilibrium in a Stationary State; the General Considerations Involved	23
2. Three Special Cases	50
3. Conclusions of the Analysis and an Alternative Approach	55

CHAPTER III

THE ANALYSIS OF AN INVESTMENT DECISION: I

1. Introduction	65
2. The Value of an Investment when Uncertainty is Absent	69
3. Maximizing the Value of Capital	70
4. The Appropriate Rate of Discount when Uncertainty is Absent.	72

CHAPTER IV

THE ANALYSIS OF AN INVESTMENT DECISION: II The Effects of Uncertainties Upon Business Planning

1. Introduction	76
2. The Results of Uncertainty about Income	76
3. Further Discussion of Investment Plans for an Uncertain Future: The Provision of Flexibility in Plans	81
4. The Effect of Uncertainty with Respect to Interest Rates—A	82
5. The Effect of Uncertainty with Respect to Interest Rates—B	89
6. The Effect of Selling-Value of a Firm Upon Investment Plans	93

CHAPTER V

COSTS AND RECEIPTS AS DETERMINANTS OF DECISIONS TO INVEST

1. Introduction	94
2. Investments in Inventory	95
3. Investments in the Processing of Goods	96
4. Investments in Equipment	99

CHAPTER VI

PRICE-CHANGES AND PLAN-CHANGES

1. The Selling-Price of the Product	103
2. Wage-Rates and the Price of Materials (Factor Prices)	105
3. The Price of Equipment	106
4. Changes in Interest Rates	109

CHAPTER VII

A PLAN OF INVESTMENT FOR AN INDUSTRY

1. A Standard Pattern for Investments	112
2. Differential Cost and Differential Revenue Curves for an Industry when Demand and Cost Conditions are Independent of Investments	114
3. Differential Revenues and Costs from Investments in the Processing of Goods	116
4. Differential Revenues and Costs in the Disposition of an Original Stock	121
5. Differential Costs and Revenues from Investment in Fixed Plant	123
6. The Dependence of Conditions of Demand and Cost Upon the Investments of an Industry	126
7. The Determinants of Conditions of Demand	127
8. The Determinants of Conditions of Cost	130
9. Uncertainty and the Standard	132
10. Conclusion	134

CHAPTER VIII

COMPETITIVE PRICES OVER A BUSINESS CYCLE

1. The Conditions of the Problem	138
2. Discount Factors over the Course of a Cycle	143
3. Discounts for Uncertainty over the Course of a Cycle	145
4. The Standard Plan of Investment over a Cycle	147
5. The Actual Course of Investment over a Business Cycle	155

CHAPTER I

THE PROBLEM POSED

I. INTRODUCTION

INVESTMENTS are made and goods are sold within a milieu of change. Neither the demands of consumers nor the terms on which the factors of production will be supplied remain stationary for long. And about the longer trends of development run the more or less irregular fluctuations of demand and cost connected with seasons and trade cycles. Neo-classical price theory, however, is a stationary state theory. It argues that the actions of business men may be validly, if not completely, described by analysis of the incentives to action which can be supposed to exist when the general conditions of the demand for goods and of the supplies of the agents of production remain unchanged. This is true both of the theory of pure competition and of the theory of monopolistic competition. Such an argument constantly challenges investigation, and anyone interested in the influence of change must inspect it carefully and come to terms with it.

The core of neo-classical price theory is the proposition that, whatever the conditions of change, there exists a constant tendency for output to be such that marginal cost is equal to the marginal yield of revenue. Actual equality may never be attained. Adjustment to a new set of conditions takes time to accomplish. But at each instant the direction of adjustment may be taken to be correct.¹ Mistakes are made, but they are subject to correction within time limits which make it justifiable to describe adjustments in terms of the tendency stated above.

It is this proposition which the present essay proposes to examine. A critical study will be presented in the remainder of Chapter I and in Chapter II. It will be argued that the proposi-

¹ What is here in question is, of course, an adjustment correct for the time period in question.

12 PRICE THEORY FOR A CHANGING ECONOMY

tion in question is invalid in some situations and of doubtful validity in others, and that, in any event, a more satisfactory price theory can be founded upon assumptions of change. Part II (Chapters III-VIII) attempts to construct the framework of such a theory.

The study will be limited to the case of pure competition, for the author believes that both the critical and the positive aspects of the analysis are capable of extension without formal difficulty to situations monopolistic in some degree.²

2. A GENERAL VIEW OF NEO-CLASSICAL PRICE THEORY

The exposition of neo-classical price theory usually proceeds by classifying all the factors which have an important bearing on prices into five or six or seven groups; the number of classes varies with different writers. Perhaps the clearest and most thorough of these classifications is that of Professor Knight.³

He lists the following factors:

- " 1. The population, numbers and composition.
- " 2. The tastes and dispositions of the people.
- " 3. The amounts and kinds of productive capacities in existence including:
 - a. Personal powers
 - b. Material agents
 - (1) Given by nature
 - (2) Artificially produced
- " 4. The distribution of ownership of these, including all rights of control by persons over persons or things. (Impersonal control, by laws or *mores*, is indistinguishable from No. 2, tastes and dispositions.)
- " 5. Geographic distribution of people and things. This stands in close relation to the facts of technology.

² Cf. the author's article, "Monopolistic Selling in a Changing Economy", published in the *Quarterly Journal of Economics*, February, 1938.

³ F. H. Knight, *Risk, Uncertainty and Profit* (London School of Economics, Reprint, 1933), p. 147.

"6. The state of the arts; the whole situation as to science, education, technology, social organization, etc."

In addition, there is a seventh factor which is not usually specifically listed (since the lists are usually compiled in order to separate all "other" factors from it). This factor comprises the organization of production and distribution through exchange⁴ which may be said to be the special province of economics in a capitalistic economy. The factors listed above set the conditions within which the process of exchange operates including the two groups of conditions which have furnished price theory its chief problems, namely:

a. The conditions of competition and monopoly; i. e., the relations of relative rivalry or independence in which individuals may stand with respect to others.

b. The opportunities open to people to produce and offer goods for sale within certain time periods;⁵ e. g., the Marshallian long- and short-run problems.

Price theory takes its second step by showing that the first six factors together determine the quantities of each commodity which people are willing to take when various quantities of other commodities must be foregone, and also the relative difficulty of producing each commodity. In the Marshallian scheme, by assuming that the conditions of supply of all goods but one are given, it is possible to draw up a hypothetical schedule showing the rate at which a good under consideration will be demanded at various money prices and the expense of producing

⁴ This is, as Prof. Knight indicates, an aspect of social organization.

⁵ These time periods are not defined chronologically, but in terms of types of adjustments which are hypothetically open to people. In the "short-run", people are supposed to respond to a change in price by making such alterations in their rate of output as they find worthwhile without changing their existing equipment and managerial personnel. In the "long-run", changes in output are considered free of these limitations. Obviously, there is a loose connection with chronological time.

14 PRICE THEORY FOR A CHANGING ECONOMY

various quantities of the good.⁶ The supply schedule for the commodity is secured by summing at each price the amounts whose marginal cost to each producer is equal to that price.⁷

The third step is to examine the process of exchange in abstraction from changes in those factors which determine the schedules of supply and demand. By assuming that the first six factors listed above do not change, the schedules of supply and demand are rendered constant. Within this stabilized situation, business men are supposed to engage in production and exchange in an attempt to secure the largest profit they can. In conditions of competition, every business man will make his largest profit when he produces and sells at such a rate that his marginal cost is equal to the price he receives for his goods. But, at least in the first instance, sellers do not know, with anything like precision, the position and shape of the market demand curve and of their own and their rivals' cost curves. The rate of production and sale will then at first result in a price which is incorrect in the sense that many producers will find it worth their while to alter their rate of output. If a second attempt is still incorrect, a second alteration will be made. Thus by a process of production, exchange and inspection of results, the conditions of demand and supply are gradually revealed, provided that these do not change for reasons other than the process of exchange itself. This possibility, however, is ruled out of account by assuming the first six factors to remain constant. Thus there is finally a gradual approach to that rate of output and consumption in which marginal cost to each seller is equal to price. For until this rate is reached it remains to some-

⁶ Money is taken to remain of constant purchasing power. This exposition tacitly assumes that people already know their own attitudes towards the goods and services they wish to consume, and towards the various occupations in which they may seek employment, etc. Actually, they do not; but we may take these facts as stable from the point of view of the business man, since they probably change only slowly by reason of experience gained in the consumption or production of a single commodity. That is all that is under consideration at the moment.

⁷ This is true, of course, only in conditions of pure competition.

one's advantage to alter his rate of output; but when it is attained no one can find it worthwhile to change his commitments. This is the position of equilibrium and maximum advantage. Its attainment rests on the series of "experiments" in exchange within a situation hypothetically stabilized by abstracting from changes in the first six factors distinguished above.

The final step in the argument is to concede that this position of equilibrium is never attained. The independent variables—the first six factors—do change; and each change alters the position of equilibrium (which is defined by any given position of the independent variables) before the necessary adjustments can be made. Nevertheless, it is argued that the position of equilibrium appropriate to a given time may be validly used to describe the actions of individuals at that moment. For this is the result which the process of exchange *tends* to bring about.⁸ Thus the significance of the position of equilibrium defined by given stable conditions with respect to the "independent variables", is broadened to make it a valid description of the moment to moment actions of individuals in a situation of change.

This conception, if accepted, almost does away with any problem of "dynamics", so far as economics is concerned. As Professor Knight says, "The really difficult problem in the theory of progress relates not so much to the effects of particular changes. These effects, though complicated, can be traced by the application of the principles of the market, the 'laws' of supply and demand. The difficulty comes in the prediction of the changes themselves."⁹

⁸ This position is most clearly stated by F. H. Knight, "Cost of Production and Price in Long and Short Periods", *Journal of Political Economy*, Vol. 39 (1921), pp. 304-305 (reprinted in *The Ethics of Competition*, New York, 1935, pp. 186 ff., citation on pp. 187-188), but its substance is clear in most other writers. Cf., for example, J. B. Clark, *The Distribution of Wealth*, Chs. V and VI; and A. C. Pigou, *The Economics of Stationary States*, Ch. 48.

⁹ *Risk, Uncertainty and Profit* (London ed., 1933), p. 151.

If the general approach of neo-classical theory is correct, this is so. But it is the position of the present writer that this is not so, and in order to lay the basis for the argument which he believes justifies this criticism, it is necessary to examine the two devices which are central in the neo-classical analysis, namely, abstraction, and the use of the equilibrium position to describe the process by which it is reached. We shall ask, at this point, what limits there are to the use of these devices; and in the second chapter we shall try to show how these limits are transcended.

3. ABSTRACTION AND EQUILIBRIUM IN STATIONARY STATE THEORY

(1) Concerning abstraction, the first thing which must be said is that it would be impossible to do without it. In any situation conditioned by a complex of factors, the aim of study is to establish, if possible, the separate influence of each significant factor. Indeed, it may be said of all scientific generalizations that they "state what would be true of a given factor if all other things remained indifferent."¹⁰

A serious difficulty arises, however, in those cases in which the relation of the forces in question is not that of complete independence. Such independence exists, for example, in the problem of the composition of forces in mechanics. Here "each force has its own effect"; to assume "all other" forces constant allows us to state exactly the influence of the one assumed to vary. Such independence may be found in the abstraction involved in the Marshallian long and short periods. The effect of variations in working capital upon supply, with any given quantity of fixed capital, is not affected by the fact that fixed capital is also subject to variation. We may, therefore, validly assume the latter stable and study the effects of changes in the former.

¹⁰ M. R. Cohen, *Reason and Nature* (New York: Harcourt, Brace & Co., 1931), p. 359.

Not all forces, however, have this characteristic of independence of action. Two varieties of dependence may be distinguished. The first is of purely quantitative significance. Again an example from Marshall is apposite. If the first wage bargain made between workers and their employers in adjusting to a new situation is low relative to the value of the marginal product of that quantity of labor, the low wage may affect the efficiency of the workers in question. The result is to lower the value of the marginal product, and so on, perhaps indefinitely.¹¹ In such cases, it is not possible to hold the efficiency of labor constant while inspecting the process of exchange.¹² The formal difficulty, however, is not great in this case. It can be guarded against by abstracting only from changes not caused by the process of exchange itself. The real difficulty, however, remains—to discover when and to what extent the process of exchange can disturb the hypothetically stabilized situation.

The meaning of the second relation of dependence is suggested by John Stuart Mill's old distinction between "mechanical" and "chemical" combinations of forces.¹³

In economics, a good example can be given from the problems of the results of competition under static conditions. Speaking roughly, it is commonly accepted that the results characteristic of competition are secured when each seller completely disregards the effect of changes in his output upon market price. But, it has been pointed out, if conditions of supply and demand remain unchanged, and an unlimited amount of time is allowed for business men to become acquainted with the conditions which they face, then there will be a large growth of pertinent knowledge. The result will be that either collusion or combination will take place, administrative limitations being removed;

11 Marshall, *Principles of Economics*, 8th ed., Book VI, Ch. IV, Sec. 6.

12 It will be recalled that efficiency of labor was covered by one of the six factors listed above as generally held constant.

13 J. S. Mill, *A System of Logic*, Book III, Ch. VI; and Book VI, Ch. VII. The distinction, of course, is only figurative.

or else each person in the market, recognizing the price which would maximize profits in the industry will set that price, and none will cut below it since such action will be recognized as the cause of a reemergence of competition.¹⁴ Thus abstraction from change turns competitive action into monopolistic. The moral must be that competitive behavior cannot be assumed to be completely independent of change and must be studied in conjunction with some degree of change if correct results are to be secured. And this must be true generally where similar relations of dependence exist.

The example we have just used illustrates still a third point. Where relations of dependence exist, they may be of various degrees of importance. Hence, where absolute precision is not in question, unimportant relations may be neglected. It may be found, moreover, that some relations of dependence are important in certain time periods but not in others. Thus it might be held that given stable conditions of demand and supply, competition would turn into monopoly in a sufficiently long period; but in a relatively short time, no important change would take place. For such short periods, therefore, there can be no inconsistency in assuming competition and stable conditions of supply and demand.

(2) Let us now consider the second of the neo-classical devices, the description of the actions of individuals in terms of the position of equilibrium which they would finally reach if the conditioning circumstances remained stable. We may best break the problem down into three questions: Does the hypothesis of stable demand and expenses curves define a position of equilibrium? Will it be attained? If so, is it always justifiable to define all the steps in the process of attaining it as "tending towards" equilibrium?

¹⁴ Ingenious developments of this argument may be found in F. H. Knight, *op. cit.*, pp. 141 ff.; J. M. Clark, "The Socializing of Theoretical Economics," *Trend of Economics* (New York: F. S. Crofts & Co., 1924), pp. 94 ff.; N. Kaldor, "The Equilibrium of the Firm," *Economic Journal*, 1934.

As to the first question, given the demand curve for the product and the expense schedules of the individual producers (and potential producers), there must be some level of output for each which, in pure competition, would provide no one with an incentive to alter his arrangements. For this incentive consists in a difference between price and the marginal cost of output to any producer. Since some level of output must exist, with given demand and cost conditions, in which this relation of equality will be established, this must also be a position of equilibrium.¹⁵

The existence of a position of equilibrium is no guaranty, however, that it will be reached, even in stationary conditions.¹⁶ We saw above, in the discussion of abstraction, that the process of exchange was itself capable of altering the conditions of demand and cost, and that it was not possible to abstract from changes due to that cause. In such cases, therefore, the process of reaching equilibrium itself shifts the goal; clearly it would never be attained.

But even where the process of exchange does not alter the conditions of demand and cost, equilibrium may not be reached. Sellers alter their plans of production whenever the price they anticipate differs from the marginal cost of their present level of output; the amount they produce is determined by their notions of their individual cost schedules; the price actually received is then determined by the actual shape of the demand curve. If it varies from marginal cost, a new level of output is planned, and so on. This process may or may not produce the equilibrium level of output. In fact, on certain plausible hypotheses with regard to the shape of the curves of demand and cost and with regard to the anticipations of producers, output

¹⁵ There may, of course, be more than one such position. But if any one were reached, there would be no further movement. In most situations, there would be but one such position.

¹⁶ Unless we assume perfect knowledge, we must admit that a period of adjustment is necessary, a series of trials with production and sale at various levels which *a priori* may or may not bring output to a position of equilibrium.

and price may oscillate at a constant or ever-increasing distance from the equilibrium price and output.¹⁷

Thus it is at least possible to suggest cases in which it would not be valid to use the defined position of equilibrium to describe the process of adjustment because equilibrium would never be reached. But even where equilibrium would finally be reached, there is still a question whether such a description is always valid.

What meaning can we give to the proposition, "Price and rate of output tend at each moment toward the position of equilibrium defined by the curves of demand and cost appropriate to that time." The most unequivocal meaning is that the process of exchange would finally bring those quantities to equilibrium, other things being equal. In this sense, the proposition is true. But it does not mean that, even while conditions remain unchanged, price and output will move steadily closer to their equilibrium levels. It is not only that the first adjustment to a new situation must be considered to be indeterminate so long as we regard the new situation as a thing by itself and not in terms of its antecedents. (It is the usual procedure of neo-classical theory to disregard the antecedents of a new situation.) But subsequent adjustments, at least during the early stages, may result in prices not closer to, but further from, the position of equilibrium. The result depends, among other factors, on the price-anticipations of the producers.¹⁸ It is true that when a sufficient body of knowledge has been secured by the sellers, there will no longer be any reason to expect such faulty anticipations. But the attainment of such knowledge depends on a certain degree of real stability in the conditions of supply and demand. Where such stability is not in fact found, there is no reason to suppose that the stage of adjustments in which anticipations are substantially correct is ever reached. In such situations of change, therefore, the present writer sub-

17 See below, Ch. II, p. 31.

18 This possibility is presented in detail in Chapter II.

mits that there is no justification for describing the actions of producers as tending towards the position of equilibrium defined by the conditions of the moment.

Just what degree of real stability in the underlying conditions is necessary to make such a description valid depends upon the difficulties involved in the process of correct adjustment. It is the view of the present writer that the constant use of the position of equilibrium by economists points either to a neglect of the difficulties of adjustment or to a quiet assumption of a high degree of real stability. An exposition of the difficulties encountered in the process of adjustment is the main concern of chapter II. In the opinion of the writer, an appreciation of these difficulties enforces the view that, in the conditions of change usually experienced, the use of the equilibrium device is faulty. For the difficulties appear to be great enough to make a rather long period of real stability in the data necessary. It goes without saying that no conclusive proof of this position is possible. For the purposes of the present volume, however, such proof is not necessary. For whether one takes the view that the necessary degree of stability is usually absent or only that it is not infrequently absent, one will conclude that a more general theory is desirable.

CHAPTER II

THE RELEVANCE OF STATIC THEORY TO A CHANGING ENVIRONMENT *

THE task of this chapter is to examine that proposition of stationary state price theory which gives to this system of analysis its relevance to practical affairs. The proposition in question states that those results which the processes of exchange and investment would bring about if the existing conditions of demand and supply remained unchanged, they tend to bring about at every instant even in a changing environment. Or expressed differently, there is a constant tendency to attain the equilibrium position defined by the momentarily existing conditions of supply and demand. Chapter I pointed out that this proposition was open to question at several points. Of these various difficulties we shall here concentrate on a single one which appears to the writer to be the critical question. Granted the existence of a unique position of equilibrium defined by the conditions of the moment, does the process which is relied on to reach this position in stationary conditions operate in this direction in a changing environment of the sort we know?

An answer to this question must naturally involve both an inspection of the process in question and of the relevant characteristics of changes in economic conditions today. We shall deal first in some detail with the process of adjustment, and then, more briefly, with the characteristics of change.

** Chapter II is a discussion in detail of the process by which business men may be supposed to adjust to conditions of demand and cost when these are assumed to remain constant and of the difficulties involved in concluding that this process in its early stages may generally be described as tending towards an equilibrium. Those readers who are already convinced that these difficulties are sufficient to justify the construction of a framework of theory based on assumptions of change and those who may have reached this conclusion on other grounds and who are impatient of detail may wish to skip immediately to Chapter III.*

I. THE PROCESS OF ADJUSTMENT TO EQUILIBRIUM IN A STATIONARY STATE: THE GENERAL CONSIDERATIONS INVOLVED

The first task involves a sketch of stationary state price theory, a sketch which concentrates, not on the conditions of equilibrium, but on the process by which it is attained. We shall proceed, in general, along the lines of the Marshallian system, and consider the behavior of a single industry. We, therefore, make the assumptions characteristic of analysis at this level of abstraction. These include, first, assumptions with regard to the constancy of the list of variables mentioned in Chapter I.¹ In addition, we assume that the prices of all commodities except the one in question remain constant. Given these conditions, we may take as constant (except for disturbances arising from the process of exchange itself) a demand schedule and a schedule of the marginal costs of producing the commodity in question.²

In addition, the following assumptions are necessary:

(a) Goods are exchanged for money of constant purchasing power.

(b) Competition is "pure".³

(c) It is proposed to make this first part of the analysis quite general with respect to assumptions of "time"—in the Marshallian sense of the word. Except where some specific condition is stated, the argument is supposed to apply to "market" problems and to those of "short" and "long"

¹ See p. 12, above.

² Several conditions are implied by the assumption that the schedules of demand and cost remain constant. As the text states, some have already been mentioned (in the list of Chapter I, p. 12). But still another condition must be made explicit, namely, that the consumers and the owners of the agents of production are fully aware, or completely unaware of the relative prices at which goods or employment may be secured in different industries. Otherwise the demand for goods and the supply of factors at various prices may change even though the tastes of the population, the efficiency of agents and the state of the arts remains unchanged.

³ See E. H. Chamberlin, *Theory of Monopolistic Competition* (Cambridge, Mass., Harvard University Press, 1933), Chapters 1 and 2.

periods. Similarly, unless some explicit reservation is made, the reader may assume that the demand and cost schedules used may be defined either as Marshallian short-period, or as Marshallian long-period curves. In the second section of the chapter,⁴ an attempt will be made to deal with the specific problems of the "market" and of "long" and "short" periods. Where the reader chooses to interpret the supply schedules as "short-run" schedules he must, of course, add the condition, not yet mentioned, that producers do not alter their fixed plant and managerial and supervisory staff.

(d) The supply and demand curves in question define a unique position of equilibrium.⁵

The problem is, how is this position reached? We may best begin by pointing out that *either* of two conditions would serve to establish the equilibrium position immediately—perfect knowledge or perfect mobility. Complete knowledge by each individual of his own opportunities for investment and work (opportunities conditioned by like knowledge on the part of all competitors) would clearly cause each individual to make his equilibrium adjustment at once. Perfect mobility, the possibility of changing the form and extent of one's investment immediately, and without cost, would allow business men rapidly to explore the possibilities of every situation and to adapt themselves to it in the most profitable fashion.

As a matter of fact, at least in situations which are "new" to any substantial degree, neither condition exists in anything like the requisite fashion. The first attempts of business men to adjust themselves to a new situation may, therefore, be considered as "incorrect" (divergent from equilibrium) to an unknown extent.

If the first adjustments to a new situation are incorrect, say, in the direction of over-production, this appears in a divergence

⁴ P. 50, *et seq.*

⁵ We are disregarding, as stated above, the possibility of multiple positions of equilibrium.

between price and the marginal cost of production, and a reduction in output will take place. This reduction may in some conditions bring price slowly and surely up to marginal cost. But it may also take place in such fashion that price rises above cost; then an increase in output will take place. And now price may be closer or again it may be further from cost than it was in the first place. Results will differ according as the predictions of individual business men about future prices and about their expenses of production within the period in question are better or worse. Predictions of future prices, in turn, involve some judgment with respect to the output of rivals and the shape of the demand curve for the product.

One thing is clear, however. If an industry faces the same underlying conditions of supply and demand for a sufficiently long time, then the repeated production and sale of different quantities of goods with different sizes of plant amounts to a series of experiments which will finally reveal the outline of those underlying conditions. And given this knowledge, adjustment to the equilibrium position must follow.

Another consideration is important. The increase in knowledge concerning the given stable conditions of supply and demand is predicated upon the assumption that nothing in the process of production and exchange itself will act to shift those otherwise constant conditions. Yet conditions may exist in which this may occur. Marshall has shown that if laborers receive at the beginning of a series of exchanges less than their equilibrium wage,⁶ their efficiency may be permanently reduced, thus changing the number of workers required to perform a given manual operation (which is the labor commodity actually demanded). Such permanent shifts of the conditions of supply and demand, arising out of the process of exchange and production are possible and important. But we shall disregard them in order to concentrate on other aspects of the problem.

⁶ That wage which, if established at once, would remain unchanged.

Just as important are shifts in the conditions of demand and supply which are temporary; which do not permanently alter those conditions, but greatly affect the process of adjustment to those conditions—and this is our main concern. These temporary shifts may arise whenever entrepreneurs' estimates of present costs, or purchasers' estimates of the present value of goods are affected by their anticipations of future prices. The classical example is the stock market in which the amounts offered and taken at various prices shift quickly as the traders' anticipations of future prices change. And these anticipations are affected in important fashion by already quoted prices. Thus the process of exchange itself may change the conditions of supply and demand even when all other factors are stable.⁷ But if conditions are otherwise stable, these gyrations of market conditions may delay but they cannot permanently prevent the arrival of the time when the movement of prices would no longer give rise to false anticipations concerning the future. At this point, a movement toward the equilibrium position must set in.

With this general outline of the process of adjustment in mind, we can proceed to consider it in greater detail. The general situation may be depicted in the usual diagram on the page opposite.

The complexities of the process of adjustment can best be set out if we first consider an abstract case. Let SS' and DD' in the figure represent supply and demand schedules showing the amounts which will be offered and taken in the long-run upon any assumptions whatever as to what rearrangements of their positions are open to producers and consumers.⁸ Our results can then be applied to specific cases.

⁷ The point has wider application than to the stock market. It was first presented systematically by Professor F. W. Taussig in his article, "Is Market Price Determinate?" *Q. J. E.*, 1920-1921.

⁸ The curves show the amounts supplied at various prices when any particular price has been in effect for an indefinitely long period. The reader may limit the producers' freedom to adjust fixed capital or working capital to any extent he pleases or not limit it at all. But whatever avenues of adjust-

Let us then suppose that the market opens with OA units being sold for AP_1 . Now the number of units of supply which will be produced and offered for sale at the next point in time at which the rate of output and supply can be changed and the price at which this output will sell depends on a number of factors:⁹

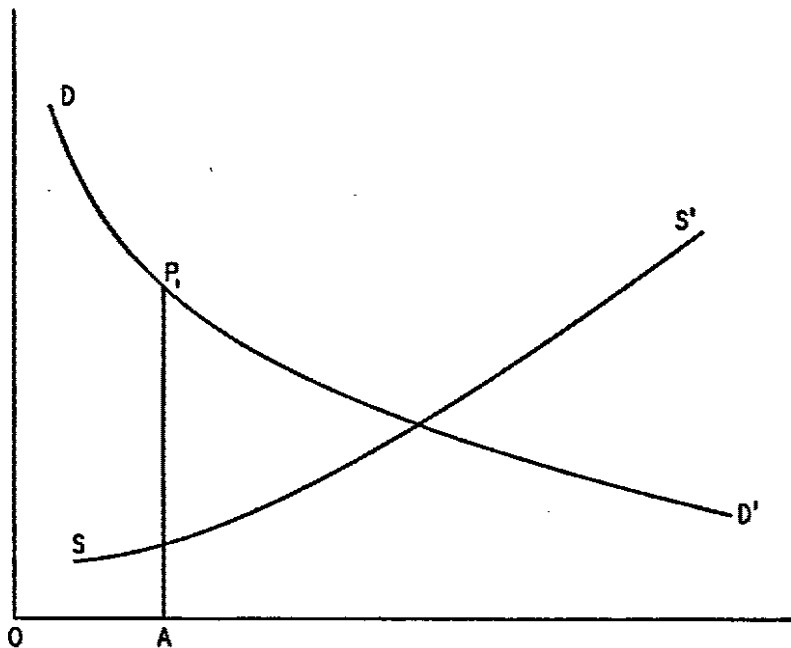


Figure 1

ment are left open to the producers, they are given an unlimited length of time to pursue them.

⁹ The following discussion depends in part on the analysis of Mr. Nicholas Kaldor, "A Classificatory Note on the Determinateness of Equilibrium", *Review of Economic Studies*, Vol. I, pp. 122 ff., esp. pp. 132-36. We shall, however, take issue with Mr. Kaldor's exposition of some minor points and consider factors on whose influence he did not touch. Cf. also P. N. Rosenstein-Rodan, "The Role of Time in Economic Theory," *Economica*, February, 1934; W. W. Leontief, "Verzögerte Angebotsanpassung und Partielles Gleichgewicht," *Zeitschrift für Nationalökonomie*, 1934, pp. 620 ff. and O. Lange, "Formen der Angebotsanpassung und wirtschaftliches Gleichgewicht," *Zeitschrift für Nationalökonomie*, 1935, pp. 358 ff.

(a) The elasticities of the curves of demand and supply. This is, of course, the most obvious determinant, since for any *anticipated* price, these curves describe the rate of supply or of consumption which individuals will attempt to achieve,¹⁰ provided the price remains in force indefinitely.

(b) The length of the period of adjustment. Time is involved in the process of changing the rate of supply and that of consumption in response to a change in price. We may measure the rate at which these adjustments take place in terms of the length of "time elapsing between the establishment of a certain price and the full quantitative adjustment to that price."¹¹ By a "full quantitative adjustment" is meant that quantity which it would most pay producers to supply if the price remained in force indefinitely. And similarly with consumers, *mutatis mutandis*.

(c) The degree of continuity in adjustments:

Changes in the rate of supply or consumption may be made gradually and continuously or it may be impossible to change the rate of production or consumption except in steps of considerable size. In agriculture, for example, a change in the rate of supply is generally large.¹² In the limiting case, which we shall call "completely discontinuous" (following Kaldor's terminology) a "full adjustment" to a given price is made in one step. In less completely discontinuous situations, several adjustments may be made before the complete adjustment is achieved. In the case of complete continuity an infinitely large number of adjustments would be necessary.

(d) Lags between changes in the rate of input and changes in the rate of output.

¹⁰ In industries characterized by "pure" competition, producers attempt to produce that amount the marginal cost of which is equal to the price they anticipate. This makes the supply curve identical with the marginal cost curve in so far as producers are aware of their costs.

¹¹ Kaldor, N., *op. cit.*, p. 133.

¹² It is only changes in the rate of supply which follow from changes in the rate of production to which this passage refers. The influences of stocks will be considered separately.

This consideration is important, of course, only on the supply side of the market. It has two aspects of importance for the problem. In the first place, if the amount demanded does not adjust itself immediately to a change in price, the rate of input will be planned in the light of demand conditions different from those which will exist when the product comes on the market.

In the second place, even in those industries in which it is possible to change the rate of input gradually, or in small steps, this does not mean a commensurate change in output until a time more or less long has elapsed. This would add nothing to the aspect of the case discussed in the paragraph above if only one "batch" of material could be in work at once (as in agriculture). But in manufacturing industry, it is generally possible to have several batches of different sizes in process at once.¹³ This delays the adjustment of supply to changes in price in a peculiar fashion which will be discussed in detail below.

These four considerations bear on the question of the quantity of goods which will be produced or taken, the anticipated price being given. A fifth consideration, then, is:

(e) The price anticipations of sellers and buyers. This is perhaps most important for sellers. For these must generally produce in anticipation of the time they sell their goods, and, therefore, must guess the price they will receive in order to plan their rate of production.¹⁴ Thus the amount produced depends directly on the price expected.

Buyers' anticipations of the future play a less direct role generally than do those of sellers—a point which deserves analysis. The amount sellers produce for sale at a certain date depends on the price anticipated and their ability to readjust

¹³ Similarly if the investments being studied are investments in plant, many factories and machines may be in different stages of completion before any one is put into operation.

¹⁴ A good part of manufacturing is, of course, done to order, and price is settled before production. We shall treat this as a special case when we discuss (below) the problem of short-run normal price.

their production arrangements. The price they will receive for that quantity (carryover being disregarded) depends on the elasticity of the demand curve for the product on the dates in question. This in turn depends on the ability of buyers suddenly to alter their former course of action, to buy and use profitably the smaller or larger quantity offered. Their attempt, would be, of course, to make such a complete alteration in their affairs, that, for the changed rate of supply, they would find it worthwhile to offer only the "normal" price. But generally their offer schedule will be less elastic than this would imply. In part, this is due to the fact that even granted that buyers anticipate the changed rate of supply correctly, they do not do so soon enough with the result that it is difficult for them to make a sufficient change in the quantities they purchase in the time in question. This factor was covered in our discussion of the "period of adjustment". In part, however, it is due to the fact that false expectations on the part of buyers cause them to make commitments whose profitability depends on their ability to secure the expected quantities of the good in question. Larger quantities are not of much use; and it will pay individuals to offer high prices at least temporarily to avoid the possibility of receiving smaller quantities.¹⁵

(f) The carryover: We have assumed hitherto that the amount produced was also the amount offered for sale. But by stocking present production, this amount may be reduced, and by drawing down existing stocks, the amount offered may be increased. And not only does the possibility of carrying stock forward affect the price received by sellers at a given time, but stocks also affect the prices anticipated by both buyers and sellers.¹⁶

¹⁵ Needless to say, this consideration is most important in the case of business men who are purchasing materials, etc., for use in production. The usefulness of one part to an automobile manufacturer depends on his ability to secure the other necessary parts.

¹⁶ The following recent articles have helped to clarify this point in connection with the process of adjustments towards an equilibrium position. J. B. Williams, "Speculation and the Carryover," *Quarterly Journal of*

Under varying combinations of assumptions with regard to these determinants of the process of adjustment, it has been found possible to construct cases in which price (a) gradually approaches the position of equilibrium; (b) oscillates about equilibrium with a constant amplitude; and (c) experiences ever-increasing oscillations.

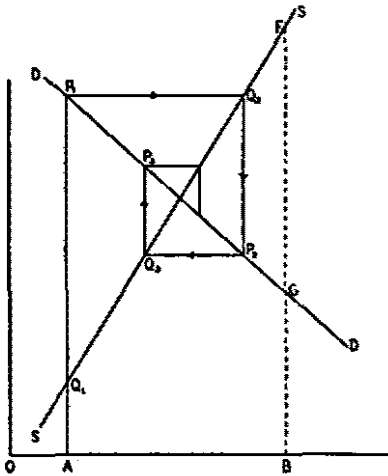


Figure 2

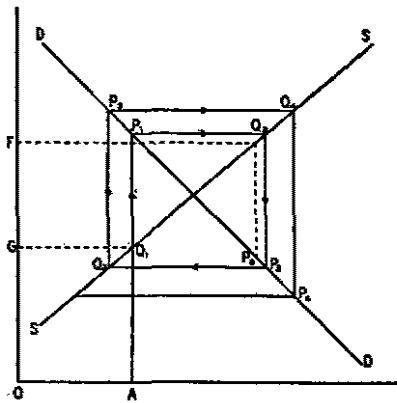


Figure 3

(1) The simplest of these cases was presented some time ago in publications by Professor Henry Schultz and Professor U. Ricci.¹⁷ The question of the tendency towards equilibrium was found to depend on the relative slopes of the supply and demand curves. The assumptions involved in this case apparently are:

(a) Adjustments are completely discontinuous, i. e., a full adjustment is made whenever supply or demand respond to a

Economics, May, 1936, pp. 436-455; L. M. Lachmann, "Commodity Stocks and Equilibrium," *Review of Economic Studies*, June, 1936, pp. 231-234.

¹⁷ H. Schultz, *Der Sinn der Statistischen Nachfragekurven*, *Veröffentlichungen der Frankfurter Gesellschaft für Konjunkturforschung*, Heft 10, p. 34 (1930); U. Ricci, "Die Synthetische Ökonomie von Henry Ludwell Moore," *Zeitschrift für Nationalökonomie*, 1930, p. 649.

changed situation; and only one batch of material can be in process at one time.

(b) The adjustment period is independent of the size of the adjustment to be made, and is the same for adjustments of all sizes.

(c) Demand reacts instantaneously (as well as fully) to price changes. This eliminates the need to specify some condition regarding buyers' anticipations.

(d) Producers expect current prices to continue.

(e) There is no carryover. Production is sold for what it will bring. (This condition necessarily follows from d.)

The adjustment can be depicted in the "cobweb" diagram on page 31.

We may assume that the market opens in each case with a supply of OA , marked Q_1 , selling for AP_1 (P_1). Then after a time, determined by a period of adjustment, supply will move to Q_2 and price will fall to P_2 . Supply will then change to Q_3 , and price to P_3 , etc. In Figure 2, the process clearly ends with price and output in their equilibrium positions. In Figure 3, just as clearly, price and output would continue to move farther and farther from these positions. In Figure 2, the slope of the demand curve is less than that of the supply curve; in Figure 3 the reverse is true. For this particular case, in which the curves of supply and demand are assumed to be straight lines, the following propositions may be set out:

(a) If the slope of the demand curve, plotted on an absolute scale, is less than the slope of the supply curve price and output will tend towards their equilibrium levels.

(b) If the slope of the demand curve is greater than that of the supply curve, price and output will move away from their equilibrium levels.

(c) If the slopes of the two curves are the same, price and output will move above and below their equilibrium levels in oscillations of constant amplitude.

It would be desirable, if it were possible, to develop similar more general rules in terms of the elasticities of the curves. But

since in general, elasticity varies along the length of the curve, no simple rules are possible.¹⁸ In the discussion which follows, we shall confine the cases in hand to those in which the curves are straight lines, so that it will be possible to make use of the rules above.

(2) The first case was marked by the assumption of complete discontinuity in adjustments. Each adjustment was made only after an interval (on the supply side), but whenever a change was made it was a complete quantitative adjustment to the price in question. But in most actual cases, adjustments may be made less discontinuously and in some cases, adjustments of input may be made virtually continuously.¹⁹

¹⁸ This suggests an alternative to the rules in terms of slopes; which however suffers from equally rigid limitations. If one has curves of constant elasticities and uses a logarithmic scale, then it is possible to set out the same rules as are set out in the text, substituting throughout "elasticity" for "slope" and "greater" for "less" and "less" for "greater."

It is perhaps necessary to point out that Mr. Kaldor (*op. cit.*, p. 135) proposes an incorrect set of rules, viz., that damped, explosive, or constant oscillations depend on the question whether "the elasticity of one curve at any price (is) higher, equal to, or lower, than the elasticity of the other curve at the same price." This is easily shown to be incorrect. Let the supply curve SS in Figure 2 move upward and to the left, its slope remaining the same. The tendency for oscillations to be damped will remain unaffected. But when the supply curve has been pushed up sufficiently, its lower end will cut the Y axis above the origin. At this point the elasticity of supply will be equal to infinity. At prices corresponding to rates of supply in the neighborhood of zero, the elasticity of supply must manifestly be higher than the elasticity of demand at the same prices.

I owe these suggestions together with the criticism of Mr. Kaldor's rules to Mr. Milton Friedman.

Professor W. W. Leontief, in the article cited above (p. 27, fn. 9) carries the discussion of this point somewhat further, but in a direction which did not prove useful for purposes of the present study.

¹⁹ The cases of "continuous adjustments" must be considered as a mathematical limit, at least where the actual productions of goods is concerned. For while it may be possible to alter the amount of materials in work almost from day to day as prices and price-expectations change, the rate of *output* can only be changed after an interval measured by the length of time required to produce a batch of goods. For the problem in hand, moreover, it is the

The difficulties in the way of handling these cases of discontinuous partial adjustments and of continuity in adjustments have been largely removed by Mr. Kaldor in the article already cited.²⁰ Only the case in which adjustments are continuous is treated, but it will be clear that the technique used by Mr. Kaldor in effect reduces this case to that of discontinuous partial adjustments. This is strictly true only where additional batches of materials are not put in work in the interval elapsing between the time the first batch of materials is put in process and the time when it reaches the market. Where additional batches are put in process in this interval an important correction must be made.

The assumptions, made in the first case, with regard to price anticipations and carryover remain unchanged. That is, it is assumed that producers always expect that the price ruling at any moment will continue to rule in the future; and no goods are carried in stock. Likewise, the adjustment period is here taken to be the same no matter what the size of the adjustment to be made; and there is no lag between a change in the rate of input and a change in the rate of output. The case of continuous adjustments can then be handled as follows. Let the period of adjustment be divided into a series of sub-periods which are small enough to make quantitative adjustments completely discontinuous within a sub-period. If the smallest period to register any quantitative change in demand or supply is a day, then one day is the period within which adjustments can be regarded as completely "discontinuous". Price can then change only once a

rate of output which is in question. The problem is to discover how a given rate of output, which we may call the "first batch" is corrected by reason of the price at which it sells. Obviously, a "corrected" batch (a "readjustment") cannot be put in work until the first is offered on the market. The "fabricating period" is, no doubt, itself variable in many cases by the application of more or less labor or motive power. But clearly this involves a change in the cost of producing a given output in a given time. In order to reduce the time necessary for fabrication to a period of very small duration, very great increases in costs would be involved.

20 N. Kaldor, *op. cit.*, pp. 135-136.

"day". One can then construct "ultra-short-period" demand and supply curves which show the quantity demanded or supplied at any price assuming that this price has been in operation only for a day.²¹ In Mr. Kaldor's treatment,²² these curves are only drawn from long-period curves as starting-points. At the points of intersection between the long period and the short period curves, the elasticities of the latter are the same as those of the former. But otherwise, the elasticity of the short-period curves, depends, not alone on the elasticity of the long-period curves, but also on the modification introduced by the "velocity of adjustment" (which we may take as measured by the ratio of 1 to the number of days in the adjustment period).

Then by applying Professor Schultz's theorem (demonstrated in the first case above) to each of the sub-periods separately, Mr. Kaldor is able to secure these results²³ (which, in the light of the discussion above, we must take to be limited to cases where the curves are straight lines):

(a) "If the velocities of adjustment are greater on the demand side than on the supply side,²⁴ movements will lead towards an equilibrium. . ."

(b) "If the velocities of adjustment are greater on the supply side than on the demand side, movements will lead away from equilibrium. . ."

To this Mr. Kaldor correctly adds that since on general grounds we may expect supply rather than demand reactions to be slow, cases of movements away from equilibrium may, so far as these considerations go, be considered scarce.

A difficulty, however, yet remains; and it will lead to a somewhat better understanding of the problem if we can clear it

²¹ In the case of discontinuous partial adjustments, one would use similar short-period curves, but they would be defined as the amounts demanded or supplied at any price in operation for the number of days elapsing between one partial adjustment and the next.

²² *Op. cit.*, p. 134.

²³ *Op. cit.*, p. 136.

²⁴ That is, if the slope of the "ultra-short-period" demand curve is less than that of the "ultra-short-period" supply curve, etc.

up. Strictly speaking, Mr. Kaldor's technique cannot carry us beyond the first adjustment to a change in price, and it is not apparent, from what Mr. Kaldor writes, how subsequent adjustments shall be described. For the base from which "subsequent adjustments" are made is one in which supply is not being produced at the "normal" cost for the quantity; nor is it being sold for the price which that amount would "normally" bring. Hence Mr. Kaldor's "ultra-short-period" curves, which are drawn from positions on the long-period curves, do not apply; and it is not clear how we are to draw the curves which do apply.

The situation may be depicted in the following manner:

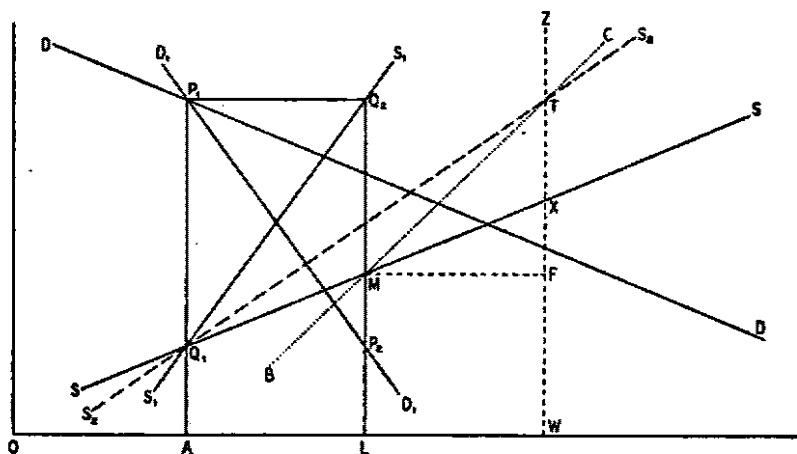


Figure 4

In the diagram above, SS and DD are long-run supply and demand curves. At the opening of the process, the quantity offered is OA (Q_1), selling for AP_1 (P_1). S_1S_1 and D_1D_1 are drawn through Q_1 and P_1 respectively to represent "ultra-short-period" supply and demand curves. The first adjustment then brings quantity offered to OL (Q_2), which sells for LP_2 (P_2). But how shall the demand and supply curves governing the next adjustment be drawn?

Let us consider the supply situation. It is clear that the curve S_1S_1 is now irrelevant; for if price had remained at P_1 , the next quantity offered would be T (assuming velocity of adjustment unchanged). For if the amount supplied increases from P_1 to Q_2 in one day (price being AP_1), then if price remained unchanged, the quantity supplied would increase by the same amount in a second day; that is, from Q_2 to T .

But this consideration fixes one point on the new supply curve. If price remained at P_1 , the quantity offered must be T . Any new supply curve must then pass through T . A line drawn from Q_1 through T (marked S_2S_2 in Figure 4) is not satisfactory, however, for it shows the amounts which would be offered at any price, if that price ruled for *two* days. But the price was P_1 for one of the days. Hence, we may say that for all (second day) prices below P_1 ($= T$), the new supply curve must lie to the right of S_2S_2 ; while for all second-day prices above P_1 , this curve must lie to the left of S_2S_2 . That is, the amounts shown by the S_2S_2 curve are too low for all prices below P_1 , for price was as high as P_1 for one of two days. Similarly for all prices above P_1 , the S_2S_2 curve shows quantities which are too great, for a price as low as P_1 was in existence for one of the two days.

Furthermore, for all prices above P_1 , the new curve must lie to the right of ZW , (drawn through T , perpendicular to the base line); for T is the quantity which would be produced if P_1 were the price ruling for two days, and in this region we are postulating second-day prices higher than P_1 . For similar reasons, the new supply curve must lie to the left of ZW for prices below P_1 .

For prices between X and F , however, the new supply curve must lie to the left of SS (the long-run supply curve); for in this region, it is a question of offering *more* than Q_2 at a lower price and if these rates of supply could be achieved at all they could never be greater than the long-run rates. For prices below F ($= M$), the amount offered may be Q_2 or less; and for price A Q_1 , it *might* be as little as Q_1 ; but it should be greater, on the

general rule that the new supply curve lies to the left of S_2S_2 in this region. How closely the new supply curve will come to Q_1 at price AQ , will depend on the rate at which it is possible for producers to free themselves of commitments undertaken in adjusting to P_1 . If they are not perfectly free then the new supply curve must cut SS between Q_1 and M .

The limits may then be summarized as follows:

(a) For second-day prices above P_1 , the new supply curve must lie within the triangular area ZTS_2 .

(b) For the prices below P_1 , within the irregular area bounded by the broken line $TXML$ as a maximum, and TS_2 as a minimum.

(c) If we adhere to our practice of considering only linear supply curves, the minimum above T and the maximum below T would be given by a line drawn through M and T , marked BC in Figure 4.

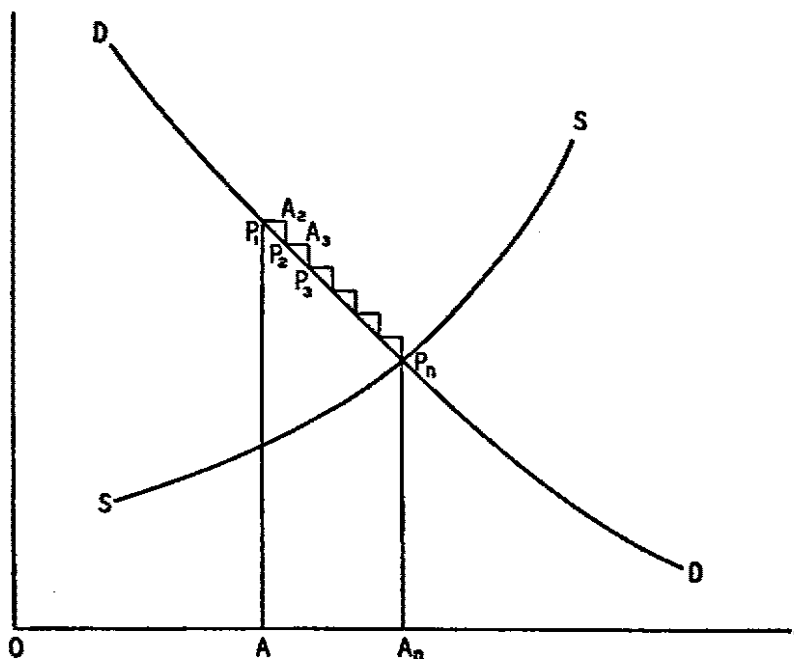
Similar considerations naturally apply in drawing the second "ultra-short-period" demand curve.

This elaboration of Mr. Kaldor's technique is set out, not because it leads to any definite solution but because it brings out the fact that the shapes of "ultra-short-period" curves are not conditioned solely by a "velocity of adjustment" reckoned from positions on the long-run curves. They are also affected by the particular series of adjustments previously made. If a third set of curves were to be drawn for the example in Figure 4, its determinants would be still more complicated since the events of two previous days would affect the conditions of the third.

It is clear that it quickly becomes impossible to take account of all the complexities which envelop the process of adjustment. It is necessary to state, then, that one cannot set out the conditions in which, under the assumptions so far made, the process will lead price towards the equilibrium position defined by the conditions of demand and cost applicable to the industry if an indefinitely long period were allowed for adjustments.

It is possible, however, to point out that it is extremely unlikely that explosive oscillations of price could continue for long. For over short periods there are, beyond a certain point, rigid limits on increases in the amount supplied at any price. This means that when price rises beyond a certain point, the supply offered no longer tends to increase; and this means that price will not fall as far as it otherwise would. But there is no way of knowing whether this fact will cause price to move gradually to the equilibrium position, as defined above, or not.²⁵

²⁵ Mr. O. Lange, in the article cited above, p. 27, fn., suggests that where adjustments in supply can be made continuously (and presumably where it is true that either (1) only one batch of goods can be in process at once, or (2) there is no lag between a change in the rate of input and a change in the rate of output), the process of adjustment may be depicted as follows:



Let AP_1 be the price ruling when OA is the amount supplied. This will cause producers to begin to increase their output gradually. As a somewhat increased supply A_2 reaches the market, price will fall to P_2 . This still leaves an incentive to increase production, and it is extended to A_3 , causing price

This concludes what we have to say on the case of "continuous adjustments". As we have pointed out, the analysis applies as well to the case of discontinuous partial adjustments, when corrections have been made for two important difficulties. The first is on the side of demand.

(3) We have been assuming that the entire reaction of demand to change in price (whether appropriate to a "day" or to some longer period) takes place at the moment when a changed rate of supply reaches the markets and that no further adjustments take place on the demand side before the market experiences still another change in the rate of supply. This assumption is a plausible one for conditions in which supply adjustments are continuous, but it is not plausible wherever any considerable periods elapse between changes in the rate of supply.

Let us make the case somewhat more concrete. Suppose the conditions are such that the rate of input can be changed once a week and that a week is necessary for raw materials to be worked up into finished products. (This makes the "ultra-short period" of the previous case a week long.) Every Monday, then, the batch of goods produced during the past week reaches the market and the new material is put in work for the ensuing week. It is not possible, however, to allow a week for conditions of demand to respond to the changed rate of supply. For the new batch begins to be marketed immediately. The impact of a changed rate of supply will, therefore, have a much greater effect upon the price than it would if the buyers had, say, a

to P_n , and so on until the amount supplied reaches the amount A_n and price has fallen to the equilibrium level $A_n P_n$ —and if output increases beyond this point, the reverse process comes into play.

The crucial assumption of this demonstration which Mr. Lange does not make explicit, is that there must be a full and immediate adjustment of demand to every change in price. But if this be not the case, a small increase in the amount supplied will cause a larger change in the price than the diagram above shows. An important element in the situation is neglected.

week's warning that there would be a change in the quantity of the commodity offered.²⁶

This consideration, moreover, has more than a transient effect. For the producers' plans concerning production during the ensuing week are affected in part, at least, by the price established by the impact of the new rate of supply. If so, this is a fact which will tend to hinder movements towards the equilibrium price in the cases set out above, although in other cases, its effect may be the opposite.²⁷

(4) The second difficulty is on the side of supply. The case of continuous adjustments has thus far been considered upon the assumption that no appreciable interval elapses between the time a batch of material is put in work and the time it reaches the market. Hence there is no question of further batches put in process in the interval. When we apply the results of this case to situations in which adjustments are discontinuous, we are, therefore, implicitly assuming that in fact, no materials are put in process until the previous batch is marketed. If this is not the case, a correction must be made.

Let us suppose that the processing of additional goods can be commenced before the first batch is sold. Then, if price be above cost, the rate of "input" will continue to expand at least until the first batch reaches the market. Each successive batch should be larger than the preceding one since more time was available in preparing to produce it. (The limit to the expansion would be a batch equal to the "normal" size for the price expected.)

If, when the first batch reached the market, price fell below the expected marginal cost of the last batch in work, the process

²⁶ See p. 29, above, for cases in which one would expect that demand would respond to changes in price at a limited rate over time.

²⁷ See the section on Anticipations, below p. 43. In some of the cases examined there, it appears that movements towards equilibrium are encouraged the more as changes in supply have a greater effect on price.

of contraction would commence.²⁸ If not, the expansion would continue until at last one batch reached the market for which the price received was smaller than the expected marginal cost of the last batch in work. The next batch put in work would now be smaller than the last, and the process of contraction would continue, since for some time, batches of increasing size would be coming on the market. The contraction would continue until one batch is marketed whose price is equal to the expected marginal cost of the last batch put in work. The process is then reversed again.

The net effect must be greatly to decrease the influence for stability which is otherwise to be attributed to the slowness with which adjustments are made on the side of supply. For the possibility described indicates that supply may continue to be expanded for some time after the rate of production has reached a point which must cause price to fall.

It must be noticed, that the disturbing effect of this possibility is mitigated to the extent that producers anticipate the effects on the price of earlier batches, in process but not yet marketed.

The argument to this point has necessarily been inconclusive—no doubt, there is no valid generalization to be made which covers the entire field of industry. In the more simple situations studied, cases were found in which movements lead away from equilibrium as well as cases in which an equilibrium would be reached. When more complicated conditions were studied, it was not possible to say to what results the process would lead, although some factors were noticed which tend to limit and damp the oscillations of price and output, and others which tend to aggravate these oscillations. But we have thus far disregarded the influence of price-anticipations²⁹ and of the holdings of stocks.

²⁸ It need not necessarily do so, since the marginal cost of additional output falls as more time is allowed for its preparation.

²⁹ We have actually been assuming that traders anticipate that present prices would continue.

(5) The influence of price- and cost-anticipations.

Let us first consider the influence of price and cost anticipations without admitting the possibility of holding stocks of goods. Let us revert, moreover, to the simple assumptions which ruled the first case set out above.³⁰ Let us take as "neutral" (in order to distinguish the effect of anticipations from conditions previously considered) the expectation that current prices will remain constant and the condition in which producers anticipate their costs correctly. Then an inspection of Figures 2 and 3 quickly reveals the general effect of various alternative anticipations.³¹

(a) The anticipation of a price lower than P_1 (this price being current) must always hasten the progress towards equilibrium or retard movements away from equilibrium (given that costs are correctly anticipated) so long as the anticipated price is not below the equilibrium price. The anticipation of the equilibrium price is, of course, the perfect prediction from the point of view of reaching that position.

(b) The same remarks hold true for price-anticipations below equilibrium, so long as the expected price is not lower than P_2 . And movements which, on "neutral" expectations, would be towards equilibrium cannot be given a reverse tendency unless the expectation is for a price below $A Q_1$. Movements which would be away from equilibrium can be given a tendency toward equilibrium if one of two conditions holds:

(1) If the price (Fig. 3) is expected to be above equilibrium, but below P_1 , then any expected price below OF will bring forth such a rate of supply as to produce a price higher than P_2 , which in this diagram lies just as far below the equilibrium price as P_1 lies above it. Whether the next adjustment of supply will yield a price below P_1 depends upon the level of the price resulting from the first adjustment and upon the expected price which rules plans for the second adjustment of supply.

³⁰ See above, p. 31.

³¹ See above, p. 31.

(a) If the price (Fig. 3) is expected to be below the equilibrium price, the tendency (on "neutral" price expectations) away from equilibrium can be reversed if the price expected is between the equilibrium price and price O G. For an expectation of price O G would mean a supply of O A, which means a repetition of the initial price, A P₁.

(c) Anticipated prices higher than P₁ (Fig. 2) will always retard movements towards equilibrium and aggravate movements away. But movements which, on neutral expectations, would be towards equilibrium cannot be given an opposite tendency unless the anticipated price be higher than B F. For the expectation of this price will cause supply to be increased to such an extent that price will fall to B G which is as far below equilibrium as P₁ is above it. But the tendency of price to move towards equilibrium will, of course, reassert itself unless there is again an expectation that price will be below the ruling price.

The more nearly equal are the slopes of the curves of demand and supply, the more significant does this possibility of a movement away from equilibrium become for when these slopes are equal, the anticipation of a price only slightly different from the ruling price will be sufficient to secure the effect. And the same applies to what was said in paragraph (b) with regard to the possibility of reversing movements away from equilibrium.³²

(d) Turning to costs, overestimates of the expense of producing (when price is above equilibrium and an increase in production is planned) will hasten movements toward equilibrium and retard those away from equilibrium. When price is below equilibrium, and a decrease in production is planned, the reverse is true.

So much is clear; but it is more to the point to attempt to say something of the influences involved in the formation of

³² All that has been said in the preceding paragraphs applies, with language reversed, when price is initially below equilibrium.

various anticipations. Here we must concentrate on the period covered by the first few adjustments to a new situation. For, given a stationary state, anticipations would eventually become "correct", in the sense that each individual would know the equilibrium price and level of output. This level would always be attained in the end. The conditions of supply and demand, however, alter long before this degree of knowledge is attained. Hence we must concentrate on the period during which little is known about the shape and position of the demand and supply curves currently in effect, a period in which they have been so recently established that the possibility of further change is inevitably a factor in the plans of business men.

We shall set out our analysis in terms of that level of production which would be the result of what we have called "neutral expectations", i. e., expectations that current prices will continue and estimates of cost which are correct. Our point of departure is a situation in which price is above equilibrium.

(a) The conditions for the production of a smaller quantity than that based on "neutral" expectations.

A smaller quantity would be produced if either a lower price were anticipated or if costs were overestimated. A lower price would be anticipated on one of two conditions. If the conditions of demand were expected to remain constant, then producers generally must expect their rivals to produce a larger amount during the next period. This is perhaps the most natural assumption for producers to make at a time when the general experience of the market is that prices are above the cost of producing additional output. A producer needs only to attribute to his rivals an experience similar to his own in order to conclude that their output will be larger. It is barely possible that producers might expect their rivals to anticipate a fall in demand, but they would hardly do so when they themselves are calculating that an increased rate of production would be profitable.

A lower price would also be anticipated if demand is expected to fall off even if the business men think their rivals will pro-

duce at an unchanged rate. This again is an unlikely event when the experience of producers generally has been that they could have produced a larger quantity profitably in the current period.

Finally, even if price expectations are "neutral" a smaller quantity (than that based on "neutral" price expectations) would be produced if business men overestimated the costs of extending their output under given cost conditions, or if they expected cost-schedules to move up. Both are possible and in some situations probable. The use of arbitrary accounting systems which include uniform percentages of mark-up over prime cost may often bring the first possibility to pass. And in certain phases of the business cycle, producers may overestimate such general increase in costs as may actually occur (or underestimate general decreases in costs).

These considerations lend support to those factors which encourage movements towards equilibrium and retard movements away. But if they are present in an exaggerated degree, the opposite may be true.³³

(b) Conditions for the production of a larger quantity than that based on "neutral" anticipations.

This may occur either when a price higher than that current is anticipated, or when costs are underestimated.

A higher price might be anticipated when demand is expected to increase. In this event, the smaller the increase in supply expected from rivals, the more likely is it that a higher price would be anticipated. Rivals would hardly be expected to lower their rate of production, unless each producer figured that others expected demand to fall. But a producer would be hardly likely to do so when he himself expected conditions of demand to improve.

An expectation of an increase in demand may, however, be widely held. This must be especially probable whenever the high price currently being secured by producers has itself been

³³ See paragraph (b), p. 43, above.

secured because of an increase in demand and not because of a previous decrease in the rate of supply.

Again a "larger" quantity may be produced when price-expectations are neutral provided the costs involved in increasing production are underestimated. Aside from ordinary cases in which costs are not well known, it is probable that costs are habitually underestimated in those critical regions of the cost curve in which additional production requires an addition to overhead in order to keep efficiency high.

These considerations support those factors which aggravate movements away from equilibrium and retard those factors making for movements toward equilibrium. It is clear that they would hardly be of much weight in the later stages of a process of adjustment. For then demand would never be expected to change. But in the early stages of adjustment, high prices may often cause producers to anticipate still higher prices in the future.³⁴

5. The influence of stocks.

The analysis to this point has preceded on the assumption that producers offer their goods on the market without reserve, that no goods are carried to stock and none is sold from stock. This, however, is true only for goods for which the costs and risks of storing are far greater than any possible profits from such operations. In the case of staples which are not highly perishable, variations in the quantities stocked are an important influence on the price.

In general, goods are stocked whenever the difference between the present and the expected future price of goods is considered sufficient to cover the cost and risks of storage.³⁵ Hence, the theorists who proceeded upon the assumption that business men expected future prices to be the same as current prices never took variations in stocks into consideration. But

³⁴ Again, the exposition set out above applies when prices are below equilibrium, the language being reversed as required.

³⁵ See below, Chapter VII, pp. 117-123.

this must be done as soon as we admit that expectations of future prices are possible which are different from current prices.

We can break our analysis into several steps. In the first place, let us assume that producers' price expectations are "neutral", in the sense defined above, but that a group of traders are also active in the market who speculate upon the future price and are willing to stock goods in support of their speculations. In this case, the effects of stocks on prices are confined directly to the added demand or supply brought to the market by the speculators. Producers assume that current market prices will remain constant.

If we break into the process when quantity is at Q_2 in Figures 2 and 3, then in those cases in which speculators anticipate correctly the actions of producers (whose price-anticipations are here assumed to be "neutral"), the speculative operations must serve to aid movements towards equilibrium and to retard movements away from it. For in this case, the speculators will expect a higher price in the future. They will, therefore purchase goods for stock in the present. Current price will, therefore, fail to sink as far as it otherwise would. And producers consequently will not restrict production so far as they otherwise would. In the next period, speculators will dispose of their stocks, preventing so violent a price rise and damping the future increase in production, etc.³⁶

Speculators may, however, guess the future incorrectly. They may, in line with our analysis of price-anticipations, expect a price lower than that current at the very time when producers' price-anticipations are leading them to restrict output. In that event, they would dump their holdings on the market, depressing the present price, and causing an even greater restriction in production than would otherwise have occurred.³⁷

³⁶ Cf. J. B. Williams, "Speculation and the Carryover," *Quarterly Journal of Economics*, 1936, pp. 436-455, for an analysis of the stock operations of speculators.

³⁷ Their sales of future contracts would have the same effect.

Such "incorrect" operations by speculators are the more to be expected in the atmosphere of a speculative market. The occurrence of a drop in price may cause a still lower price in the future to be expected. Price movements are taken as portents for the future.³⁸ Moreover, speculators stand to profit just as much by fomenting movements away from equilibrium as by movements towards it, provided they can avoid being caught at the time when movements reverse themselves.³⁹

There is still another factor present in the situation. Movements of stocks affect the plans for production directly as well as through their effect on present and future prices. Here we relinquish our assumption that producers expect present prices to remain unchanged; for variations in stocks affect producers' estimates of future prices. It is not at all clear, however, what that effect must be.

If demand is generally expected by producers to remain unchanged, then the accumulation of stocks, which must be sold later, may cause them to expect lower prices in the future than they otherwise would. And if the accumulation takes place at a time when prices are low, say at P_2 in Figures 2 and 3, this must act to restrict production more than it otherwise would be restricted. This would be a factor making for instability of price.⁴⁰ Whether this influence on the anticipations of producers is sufficient to counterbalance the effects of the rise in current price directly due to the operation of buying goods for stock, cannot be told with certainty. If speculators take into consideration the change in producers' price-expectations due to the accumulation of stocks, and if they do so correctly, the added restriction of output would only counterbalance the additional stocks accumulated in anticipation of the restriction. The speculators may either overestimate or underestimate the

38 Cf. F. W. Taussig, "Is Market Price Determinate?" *Quarterly Journal of Economics*, May, 1921.

39 Cf. E. H. Chamberlin, *op. cit.*, pp. 28-29.

40 Cf. J. B. Williams, *loc. cit.*, p. 442.

influence of their operations on the price-expectations of producers.

On the other hand, the traders purchasing goods for stock are expressing their faith in future prices which are higher than present ruling prices. If producers reason similarly, they will take the accumulation of stocks as an omen of higher prices and will act accordingly.

Finally, it has been suggested that variations in stocks are accepted by producers as portents of future movements in demand; the sign of increasing demand being the depletion of stocks, and vice versa.⁴¹ In so far as this is so, it reinforces the argument that on occasion, the receipt of a high price is taken as a sign of higher prices in the future. If so, it represents a division of opinion in the market, for it itself the depletion of stocks represents a lack of faith in the future on the part of those who are liquidating their holdings. Nevertheless, in so far as such depletion is interpreted favorably by others in the market, it makes for instability at times when prices are high⁴² and for stability when prices are low.

Thus the effect of speculation and of variation in stocks cannot be taken as making uniformly for movements in the direction of equilibrium. Contrary effects are also possible.

2. THREE SPECIAL CASES

The argument presented thus far has pretended to be quite general. The demand and supply curves in question were supposed to be interpretable at the option of the reader to apply to either the trading of a given amount of goods already produced, to the production of goods with a fixed supply of capital equipment, to the production of goods with a variable supply of fixed plant, or to other cases which the reader might have in

41 M. L. Lachmann, *op. cit.*, p. 233.

42 Of course, if stocks were accumulated when prices are high, and if producers accept this as a competent expression of faith in the future, this would represent a unanimous opinion that demand was increasing.

mind.⁴³ This general analysis of the process of adjustment may well be amplified by considering it in relation to three classic cases: "Market Price", "Price in the Short-run", and "Price in the long run".

(1) Market Price.

In this case, the amount of goods in hand and in sight is given, but not necessarily known with any approach to certainty. The curves of supply and demand are defined upon the assumption that price-expectations of the traders do not change for reasons external to the process of trading itself. In general, traders will offer a larger quantity and will take a smaller quantity the higher is the price. This must be true since the higher present price, the less, given expectations of future prices, is the profit in holding goods for the future.

For our purposes, the distinguishing characteristic of this problem is that there is, at least where the market is at all well organized, virtually no lag in the adjustment of the quantity demanded or supplied to changes in price. We have to do, then, not with "ultra-short-period" curves whose slopes depend upon velocities of adjustment,⁴⁴ but with the slopes of the basic curves themselves. We shall assume, furthermore, that the commodity is capable of being held for a future date. For if it be swiftly perishable, it must be thrown on the market without reserve as soon as deterioration threatens and some equilibrium would soon be attained.

Under conditions in which the commodity can be carried over, offers and bids will usually be made subject to price reservations. Offers will quickly be withdrawn as the price falls, while bids will quickly increase. And similarly the amount bid for will quickly decrease as price rises and the amount offered

⁴³ The discussion of the influence of stocks is an obvious exception. Here there was considered the influence of stocks upon adjustments in current production.

⁴⁴ See above, p. 34.

will quickly decline. Such a process must soon lead to the establishment of a stable price.

This argument, however, neglects a vital point, namely that the process of trading can itself alter the traders' expectations of future prices. If it does so, the schedules of offers and bids at current prices must be revised.⁴⁵ For example, if the market opens with a high price, this may cause dealers to expect a still higher price in the future. In consequence, dealers will revise their mental schedule of offers and bids. Sellers will hold back, offer less at the price in question; buyers will rush in, bid for more. The result is that price will, produce similar effects upon the schedules of offers and bids; and the process may be cumulative. In this case the tendency towards an equilibrium price is defeated.

No doubt, as Professor Taussig has pointed out, the process is possible only within limits, within a "penumbra".⁴⁶ Beyond a certain point, a rise or fall in price will be checked. For sooner or later it must be recognized that the quantities which consumers can be expected to absorb (or do without) at the prices in question, are limited. Then price must fall (if it has been rising) and the possibilities are at hand for a cumulative career in the opposite direction.

It will be recognized that the operations of professional traders must often work to aggravate price oscillations within the "penumbra". For they can make profits both from movements towards and movements away from equilibrium, so long as they can anticipate the movement. They seek to ensure the correctness of their own anticipations by spreading rumors of the direction which price will take, or by seeking to create impressions, false or true, of the state of demand. Hence the bear raids and bull campaigns, etc. And each change of price, at least for a time, works to confirm the impression that the next change will be in the same direction.

⁴⁵ Professor F. W. Taussig has described this phenomenon of market trading and has dubbed it the "penumbra effect," *op. cit.*, pp. 394-441.

⁴⁶ F. W. Taussig, *op. cit.*

No doubt all this can be possible only while the conditions of supply and demand remain uncertain. But it is precisely this phase of the process of adjustment in which we are interested.

(2) Price in the Short-run.

In this case, the demand curve describes the quantities of a commodity which people will buy per unit of time, other things being equal. And under the same conditions, the cost curve describes the expense in the long-run, of producing various quantities per unit of time with the existing equipment, management organization, etc.

The first point to be noticed is that the "cobweb" analysis on which our discussion is based, applies directly only to industries which produce in anticipation of sales. Some revision is necessary if production is to order. The two cases will be discussed in turn.

a) Commodities produced in anticipation of sale.

With regard to this case, the velocity of adjustments on the side of supply is likely to be smaller than on the side of demand. But against this factor must be placed that influence for instability which exists when several batches of material can be in process at the same time. If additional batches can be put in process during the interval between an initial adjustment of production to price, and the time the first batch is ready for sale, they are likely to retard progress toward equilibrium and aggravate movements away from equilibrium.⁴⁷ This factor is of no importance in agricultural industries, for there only one batch can be in process at a time. But it is likely to be of considerable importance in manufacturing industries.

Anticipations of the movements of price and of the cost of producing various quantities of goods are constantly being made and can be a factor either aiding or retarding movements towards equilibrium. But if the latter, they would also nullify

⁴⁷ See above, p. 41.

the stabilizing effect which the accumulation and depletion of inventories would otherwise have.

One example of faulty anticipation of costs is pointed out by Professor J. M. Clark. Business men, he suggests, generally consider that additional business can be taken on at very little additional expense; they figure that the prime cost of business remains about constant. But outside of a certain range, this is not true. Marginal costs begin to rise very rapidly, and this critical point is often disregarded by business men.⁴⁸ In so far as this is so, mistakes in expansions of output are aggravated.

b) Production to order.

In this case the selling is done prior to production by book-orders. Sellers attempt to book such a quantity of business as will make marginal cost and price equal, lowering price if business is not coming in fast enough. Since there is no reason why price should not be lowered gradually, there would seem, at first glance, no reason why there should not be a steady progress towards equilibrium.

The difficulty, in so far as it exists, lies in the possibility of "penumbra" effects. The existence of a high price may make buyers afraid of a still higher price, causing a rush to put in orders. This may cause producers to put up their price not only sufficiently so that it will cover the marginal cost of the business being offered, but even further in order to keep their plant free for a possible additional increase in demand. The reverse phenomenon may be found if a low price is first established.

Again, it must be said that these cumulative rises or drops in price can occur only within (uncertain) limits, but it is not possible to say how large or small these limits are.

(3) Price in the Long-run.

In this case, the demand curve describes the quantities which would be bought at various prices per unit of time when all adjustments have been made; and the cost curve describes the

⁴⁸ Clark, J. M., *Economics of Overhead Costs*, pp. 214-215.

expense of producing various quantities of the commodity per unit of time given sufficient time to adjust all the factors of production involved in the production of the good.

The factors which need stress in this case are two. In the first place, the relative slowness of adjustments on the side of supply, which is probably greater in this case than in those previously considered. This is an influence aiding movements towards equilibrium. The second factor bears on the other side of the question. This is the long interval which often must occur between the investment of capital and the time the finished products reach the market. During the interval many additional investments may be made which would never have been made had their promoters awaited the results of previous additions to capital. This is a factor retarding movements towards equilibrium.⁴⁹

3. CONCLUSIONS OF THE ANALYSIS AND AN ALTERNATIVE APPROACH

Our object in the discussion above was to examine the justification for describing the actions of individuals as movements which tend towards that position of equilibrium which is defined by the conditions of demand and cost existing at a given moment. It was conceded at once that if the conditions of supply and demand remained unchanged long enough the equilibrium price and level of output would become known and would be attained at last. But it was emphasized that a different situation ruled during the very early stages of the process of adjustment, and the analysis was constructed to investigate the character of these early adjustments.

During the period covered by the early stages, we found that supply and demand curves could have such relative slopes—that adjustments of supply and demand to price could be made at such relative rates—that even where the price anticipated by

⁴⁹ See above, p. 41.

the producers was not very far from the equilibrium price the resultant prices and levels of output were not in the direction of equilibrium. Furthermore, it was shown that, even where movements would be in the direction of equilibrium if producers anticipated that current prices would continue, these anticipations may not exist. Indeed, so far as these early adjustments are concerned, an increase in price, for example, may lead to the anticipation of still higher prices. In this case again movements of price and level of output tend to be in a direction away from equilibrium. In short, movements occurring within the period investigated may be either towards or away from equilibrium. The data usually considered in price-theory do not serve to render the tendency determinate. The general practice of describing all movements as tending towards equilibrium is, therefore, not justified for the period in question, unless there is specified the relative velocities of adjustment of demand and supply, the price-anticipations of sellers and buyers, etc.

The significance of this conclusion turns on the question, whether changes in the conditions of supply and demand occur with sufficient frequency to justify the conclusion that the period of adjustment analyzed above is the usual condition of industry. The present writer believes that this, in fact, is the case.

The curves of supply and demand which apply to the cases of short-run and long-run price are defined by the assumption that the amounts bought at various prices and the expenses of producing various quantities remain stable on the average—taking good years with bad, one season with another.⁵⁰ Oscillations of the seasonal and cyclical varieties are neglected; and a change in the data to be relevant to the problem must be a change due to the influence of more permanent forces which both price-theorists and statisticians would call "secular".

Now it may be argued that changes due to such secular influences are slow and fairly regular; that in consequence,

⁵⁰ Cf. Alfred Marshall, *Principles of Economics*, 8th ed., Book V, Chap. V.

changes of this sort may be anticipated by investors with a high degree of correctness. Or if not anticipated, it may be supposed that adjustments on the basis of experience may quickly be made—quickly relative to the rate of change in the data themselves. By a series of experiments, producers may familiarize themselves with the conditions of demand and cost, and establish such rates of investment and output as would cause price to move towards its equilibrium level.

This might be true if the conditions of demand and supply were, in fact, affected only by "secular" influences. In fact, however, seasonal and trade-cycle factors are at work, and their effects mingle with the slower action of the secular factors. Moreover these seasonal and cyclical factors operate in an irregular fashion in themselves and, in so far as their operation is regular, this fact is hidden by random influences always present. The result is that the secular trend can only be judged by the observation of large numbers of fluctuations of the seasonal and trade-cycle variety and by the statistical elimination of these oscillations. And if the characters of these oscillations are themselves changing, the problem of elimination is enormously complicated.⁵¹

Needless to say, the successful solution of these problems is not in the hands of the business men who are making investments. Investors can only gauge the average demand and cost conditions by the roughest sort of estimates. By the time the wisdom of any given decision can be demonstrated, conditions will have changed markedly so that the "readjustment" or "correction" of past investments is, in fact, made in the light of new data.

Consider an investment in plant and equipment. Suppose this investment to have been made on January 1, 1935. It appears to be a profitable commitment for two years and then experiences a recession of demand which makes net income for 1937 very low. Shall the investment be maintained, or not, or perhaps

⁵¹ See W. C. Mitchell, *Business Cycles*, New York, 1927, Chap. III.

even extended? Clearly this second decision faces all the difficulties which surrounded the first decision, for the three years' experience with the first investment can hardly have yielded much significant information about average conditions in the future. In order that it might, the investor would have to be able to decide whether the cyclical upswing was an average upswing or not, and similarly with the downswing. This he clearly cannot do. Hence, after three years of experience, he knows no more about average conditions in the future than he did before. In fact, the second investment decision is an attempt to meet "new" conditions even as was the first.

All that is said above applies to investments in current production with fixed equipment assumed to be constant in order to isolate the effects of variations in equipment available from those of changes in the quantity of the more easily adjusted factors. For in this case, the problem is just as truly "long-run" and dependent upon judgments of the influence of secular factors as are investments in fixed equipment.

The analysis of the short-run price problem is, however, often held to be useful in studying the movements of prices in a "short-run" defined chronologically, i. e., seasonal movements, and movements over a business cycle. In this case, however, even more clearly, the conditions of supply and demand to which the rate of production must be adjusted change so rapidly that no more than a very few, perhaps no more than one of a series of investment decisions is capable of being made in the light of substantially the same conditions. For in this case, the adjustments must be made to a combination of rapidly moving seasonal and cyclical influences, not to secular ones.

When one turns to the case of market-prices, it might seem that a different conclusion is appropriate. For here adjustments may be made continuously and rapidly. The difficulty, however, is that the curves of demand and supply are defined by the assumption that the anticipations of traders with respect to future prices do not change. In fact, however, these anticipations change rapidly for reasons not connected with the process

of trading. Every day brings additional information about business conditions which changes the expectations of business men. If so, then day by day the trading is done under different conditions.

The conclusions to be drawn are these. The sorts of conditions which business men face change rapidly, so rapidly that it seems a plausible assumption that as a usual matter, the process of adjustment to any particular conditions cannot proceed very far before it must face substantially new conditions. Indeed, it must often be true that the conditions of supply and demand change so quickly that each of a series of investment decisions is made in the light of changed conditions.

The information with which the writer must work does not enable him to test whether these degrees of rapidity are the usual condition of industry or not. He is confident, however, that the reader will agree that these conditions of rapid change are found sufficiently frequently to constitute a substantial limitation upon the applicability of neo-classical price-theory.

If this be true, then the following conclusions must be accepted. In so far as a sequence of investment decisions may be made in the light of the same conditions, nevertheless, this series of decisions rarely can be carried so far as to make certain that business men's price anticipations will be such as to produce a tendency for price to move towards marginal cost rather than away from it. The analysis of the body of the chapter is, therefore, relevant. In so far as a series of decisions is not possible, because conditions change before any second decision can be made, then it is clearly impossible to base a tendency towards equilibrium upon a process of "correction," in which business men gain experience through trading. The cobweb analysis in all its variations is irrelevant in this case, and, by the same token, the position of equilibrium defined by the equality of price and the marginal cost of production at a given moment is likewise irrelevant to the description of business men's investments. For the first investment decisions made in the light of a new set of data are clearly unlikely to hit on

the equilibrium rate of investment. And if, as a matter of fact, the conditions of supply and demand change before the mistakes can be corrected, no chance in fact exists for a tendency towards equilibrium to set in. Wherever these conditions are found, the stationary state formula is invalid. A new approach is necessary.

The analysis of adjustments of output and investments to stationary conditions of demand and cost indicates that the results of business men's decisions can only be rendered determinate if all of the many factors discussed in the body of the chapter are specified. An advance in price theory, therefore, depends upon an ability to discover when these factors have one character and when they have another.

Now it is possible to conduct studies with respect to most of these factors within the framework of stationary state theory. These are: (a) the velocities of adjustment of demand and supply to price, (b) the degree of continuity of adjustment, (c) the number of "batches" which can be in work simultaneously, (d) the ability to carry goods in stock. So far as these factors are concerned, studies of the technical characteristics of various industries and of the relative preferences of consumers and owners of factors of production are necessary. But these studies may be conducted without enlarging the bounds of stationary state price-theory. For these factors are for the most part independent of change in the conditions of demand and cost.

Others of the factors upon which the results of business men's decisions turn, however, are not substantially independent of the fact of change, for these factors either are, or depend upon, predictions which people make about the future. The following fall in this class: (a) investors' predictions of future prices, (b) the demand for commodities, and (c) the supply of agents of production, and, therefore, the slopes of the two latter functions.

The anticipations of investors, consumers, and suppliers is, therefore, a necessary subject for study by price theorists.

These anticipations, however, like any other decisions and judgments, depend upon the past experience of the people holding them. Predictions of the movements of prices, sales, stocks, and so on, are made on the basis of the past and current positions of these and other elements of the business situation. If, therefore, business anticipations are significant determinants of prices, the connection between the past experience of business men and their anticipations of the future must necessarily be studied.

Now this past experience is, in general, an experience of change which leads to an expectation of additional changes in the future. This points the way to a necessary change in the structure of price theory. Instead of studying the adjustments which business men make to a hypothetically stabilized economy, it is necessary to study business men's reactions to a changing economy; for by specifying a certain background of changes it may be possible to say what sorts of changes an investor will expect, and consequently what decisions he will make.

More specifically, it must be assumed as it is in the body of the essay which follows, that the conditions of demand and cost which characterize an industry are changing in some specific fashion which is typical of the sorts of changes to which business men must actually adjust. One such typical pattern of change is the upward and downward swing of demand and costs which characterizes a business cycle of the forty months' variety. Another typical pattern of change to which industries must adjust, which is appropriately studied in connection with shorter-term problems, is furnished by seasonal oscillations of demand and cost conditions. For longer-time problems, the movements of demand and cost conditions implied in Professor Arthur F. Burns' studies of production trends⁵² may be postulated as the conditions to which investment is being adjusted. No doubt other typical patterns of changes exist and the adjust-

⁵² See A. F. Burns, *Production Trends in the U. S. since 1870* (New York, 1934).

ments of business men to these changes will be more or less usefully studied depending on the length of the period and upon the industry about which interest centers.⁵³

Having assumed that the conditions of demand and of cost are changing according to a certain pattern, it is then possible to analyze an industry's adjustments to these changes according to the following plan.

The first step is an analysis of investment decisions. This will be shown to depend upon anticipations of net income present and future, upon the rates at which future income is discounted, and upon the attitude of business men towards uncertainty-bearing. The complexities of this problem are the subject of Chapters III and IV.

In Chapter V, the net income is considered in its two aspects: costs and receipts; and the nature of these costs and receipts is set out in detail for different types of investments. In this chapter, too, the relation between costs and price is considered. In stationary state theory, the equilibrium rate of investment in an industry marked by pure competition is such that the marginal cost of output equals price.⁵⁴

In a changing economy, if business men foresaw the future correctly,⁵⁵ this proposition would still be broadly true, both cost and price being correctly defined and appropriately discounted. But in a changing economy, it will be seen that the differential cost in question includes more than expenses of production, narrowly conceived. It may also include future receipts fore-

⁵³ The reader should notice that in this scheme, stationary state theory appears as a special case: the case in which the changes to which industry adjusts proceed at a negligible rate compared with the rate at which investment decisions can be altered in the light of experience.

⁵⁴ Interest is typically disregarded either because the time involved in production is neglected or because it is argued that in a stationary state the phenomenon of interest would not be found. Cf. F. H. Knight, *Risk, Uncertainty and Profit*, Ch. II, and J. A. Schumpeter, *Theory of Economic Development*, Ch. I.

⁵⁵ Needless to say, this is an impossible assumption.

gone. And the "price" includes more than the selling value of a unit of sales. It may include expenses avoided.

Chapter VI takes a second step by indicating how changes in the price at which the product of a firm is sold, the costs of labor and materials and discount-rates, current and expected, affect the expected costs and receipts from investment, and, therefore, how the rate of investment is influenced in consequence.

In Chapter VII a third step is taken by considering how a "correct" pattern of investment for an industry over a period may be derived from the changes in the conditions of demand and cost postulated for that period. This pattern is described in terms of the rates of investment necessary over the period to equalize the differential cost and differential revenue from investment at every date over the period, both cost and revenue being appropriately discounted. It is recognized that the "correct" pattern to be followed by a series of investments cannot be laid down once and for all; for the correct investment at (say) the third stage of a series depends upon investments actually made at previous stages. A way out of the difficulty is described.

Finally it is shown that if the marginal costs and marginal revenue from investment at a certain date are given, it depends upon the anticipations of business men whether the "correct" rate of investment is adopted. If not the result can be described in terms of the relation between the differential revenue and the differential costs of the investments actually made.

Chapter VIII is an exercise in the application of the theory in a particular case, involving an attempt to derive the anticipations of business men about the future from the conditions business men typically face in the assumed situation. The case studied is the swing of demand and cost conditions over the course of a business cycle. The exercise involves the following steps. There is first summarized an authoritative description of

64 PRICE THEORY FOR A CHANGING ECONOMY

a business cycle.⁵⁶ This description is taken to be fairly representative of the conditions faced by business men in an upswing and downswing of general business. These data provide the information necessary to trace the movements of the relation between the differential cost and differential revenue from investment, assuming that the industry actually adopts the correct rate of investment on every date. It is then possible to set out a "correct" pattern of investment for the industry over a cycle.

If this cycle is typical of its kind, then if one breaks into it at any stage, it is possible to say what the general experience of the industry has been in the recent past. And from this it is possible to deduce what the expectations of the business men are concerning the future. This makes it possible to say whether the rate of investment which business men will probably adopt at that state is greater or less than the rate which would be correct. If the correct rate is not adopted—in general it will not be—this makes necessary some modification of the correct pattern for the next and succeeding stages. The same process can be repeated at the next stage, and so on until a comparison between the actual and the correct rates of investment has been secured for an entire cycle.⁵⁷

⁵⁶ The description used is that of Prof. Mitchell in the *Encyclopedia of the Social Sciences*, Vol. III, pp. 92-106.

⁵⁷ A somewhat similar plan of procedure is suggested by Mr. J. R. Hicks, "Gleichgewicht und Konjunktur," *Zeitschrift für Nationalökonomie*, Vol. IV (1932-33), pp. 444-445.

CHAPTER III

THE ANALYSIS OF AN INVESTMENT DECISION: I¹

I. INTRODUCTION.

THIS chapter and the two following propose to analyze a business decision with respect to investment, in the hope that there can be secured a statement of principle as adequate for the study of a changing environment as the older principles were for a stationary one. The statement that a business man in a stationary economy attempts to equalize marginal cost and marginal revenue states the factors on which investment decisions turn, and leads the way to a study of those factors. We seek a similar opening here. What are the factors on which business decisions turn? Naturally in a first statement of this sort, we shall not expect a very detailed answer. We look for something more revealing than the principle that a business man will do what he thinks is most profitable in the circumstances, but we cannot expect anything but a very general statement of the factors on which profitability depends.

Let us set out the elements in the case again. We shall discuss the question in terms of a "firm," meaning by this a business association in which there is a complete union of interests among the owners and in which the assets are managed

¹ The writer was much helped in the writing of this and the two following chapters by the works of the following authors: Fisher, Irving, *The Nature of Capital and Income and The Theory of Interest*; Marshall, Alfred, *Principles of Economics*, 8th ed., Book V, and Mathematical Appendix, Notes XIII and XIV; Hicks, J. R., "Gleichgewicht und Konjunktur," *Zeitschrift für Nationalökonomie*, Vol. IV (1932-33), pp. 444 ff.; Boulding, K. E., "The Theory of a Single Investment," *Quarterly Journal of Economics*, May, 1935, pp. 475-494; Samuelson, P. A., "Some Aspects of the Pure Theory of Capital," *Quarterly Journal of Economics*, May, 1937, pp. 469-496; Hart, A. G., "Anticipations, Business Planning and the Cycle," *Quarterly Journal of Economics*, February, 1937, pp. 273-297; "Imputation and the Demand for Productive Resources in Disequilibrium," *Explorations in Economics—Essays Contributed in Honor of F. W. Taussig*, pp. 264-273.

for the sole benefit of the owners. Having given this definition to a "firm", the term can without confusion be given some animality by using it interchangeably with the term "business man", conceived of as a person carrying on his affairs individually.

A firm has a set of opportunities for investment open to it. These are limited by the personal abilities and training of its members in the particular technical and organizational situation in which it stands. These opportunities are limited also by its connections in the business world and in the financial markets.

It may be taken for granted that business men try to make the most of their opportunities; and for the purposes of this essay, this is to be interpreted in a business-like fashion to mean that they desire that the value of their capital to themselves shall be as large as possible.² Hence our problem can be restated in this form: how can a business man so use his opportunities to invest as to make the value of his capital as large as he can.

It may seem strange that the objective of business dealings should be expressed in terms of capital rather than in terms of net income or profits. But in a changing economy profits do not, and are not expected to, recur in an unvarying fashion. Business men by varying the form and characters of their investments may to a substantial extent choose between plans of action which promise high net incomes at first and relatively low ones later and plans which involve the sacrifice of income in relatively early years for the benefit of greater income later. Only in rare cases is the time-location of their incomes a matter of indifference to people. But if the time of receipt makes a difference then a method is needed whereby the income of different years is rendered comparable to a man in the present. That

² In most circumstances, the value of a particular capital is not the same to its owner as it is to others. In this case, the selling value of the capital may be part of its value to the firm, and in order to take account of this business men may make investments which they would not otherwise have made. This will be taken into account in the next chapter. See below, p. 93.

For a precise definition of capital, see below, p. 67.

X:76

99

14148

method, of course, is the method of discount. The income of any future time is valued in the present at some fraction (or multiple) of itself. The whole series of income items may then be summed and compared with any other series of income items to which a similar process has been applied. These sums of the present values of a series of income items are the values to a businessman of the capitals which yield them.

At this point, it is convenient to state several definitions.³

(a) *Capital*. We shall use "capital" as a shorthand term for the goods and property-rights which in the hands of a business man yield him the chance of future income. The account to which the total income of a firm is imputed is its capital account. The value attached to this capital is the value of the income stream imputed to it. It is the object of business endeavor so to yield these goods and property-rights as to make the present value of the firm's income stream as great as possible.

(b) *Income*. This term will be taken to mean the flow of money or money equivalents imputed to a firm.

(c) *Gross Income*: The sum of all positive income elements.

(d) *Net Income*: The difference between gross income and outgo at a certain time or over a given period of time.

(e) *Outgo or Expenses*: Negative income.

(f) *Investment*: A particular commitment of capital for the purpose of increasing its value. The present value of the income to be secured is the value of an investment.

(g) *Investment Decision*: A decision with respect to the commitment of capital which may involve a change either in the amount committed to the business, in the time for which the capital is committed,⁴ or in the particular physical goods or property rights in which the capital is embodied. Thus a de-

³ These definitions follow those of Irving Fisher. See *The Nature of Capital and Income*, Appendix on Definitions.

⁴ For a method of measuring the time-period of investment, see the article by K. E. Boulding, "Time and Investment," *Economica*, May, 1936 (Vol. III, New Series, No. 10, pp. 196 ff.).

cision to increase the rate of a firm's production is an investment decision even if the decision involves no net addition to the quantity of capital (measured by cost) used in the business; for an increase in the rate of production involves at least a change in the particular goods and property rights which comprise a firm's capital.

To this point we have the following: the value of an investment or group of investments which constitute the capital of a firm, and which it attempts to make as large as possible, is determined by the flow of net income expected and by the rate or rates of discount used to give a present value to future income.

Future income, however, is uncertain; and if it is recognized to be so, as it is, then a particular item of income will not be given the full present value which the process of discounting for futurity indicates. Rather, its *chance* of occurrence will first be evaluated; and this will in general reduce the value of any given future income item.

Moreover, people are not in general neutral in their attitude towards uncertainty. To some it is an exhilarating experience; to others, a heavy burden. Thus people will, in general, not be prepared to offer just that amount for income which is uncertain as their judgment of the probability of its occurrence would indicate. They will offer more or less, depending upon their attitude towards bearing the risk involved.

These considerations arising from uncertainty will be disregarded for the present. In order to present the analysis in the clearest fashion possible, the argument will proceed, at first, under restrictive assumptions. We shall assume the following: (a) that all items of future income are definitely foreseen (or are treated as such by the business men concerned), (b) that there is a market-rate of interest at which all can borrow and lend in unlimited amounts. This implies not only that lenders have the same information as borrowers about the prospective yield of investments but also that borrowers never ask for larger loans than would be profitable in the circumstances.

(c) Further, that changes in the rate of interest are foreseen. This does not imply that the rate is the same for loans of any duration whatever. It implies only that, given the duration, the same rate is charged to all for loans of whatever amount.

2. THE VALUE OF AN INVESTMENT WHEN UNCERTAINTY IS ABSENT.

In these conditions, the problem reduces to a simple one. The value of a given investment may be expressed as the sum of values of future items of net income, each item discounted back to the present by the "appropriate" rate of discount. We do not discuss what an "appropriate" rate is. We assume a certain rate is used and leave the discussion till later.

A simple formula is that of Irving Fisher:⁵

(1)

$$V = a_1 + \frac{a_2}{1+i} + \frac{a_3}{(1+i)(1+i)} + \dots + \frac{a_n}{(1+i)(1+i) \dots (1+i)^{(n-1)}}$$

The terms in the above represent the following:

- V = value of investment.
- a = net income of a given year or income period.
- a₁ = immediate income.
- a₂ = income after one year, etc.
- i = the rate of interest used in discounting income of the period in question.

If the rate of interest used in discounting were constant over the life of the investment, we should have:

(2)

$$V = a_1 + \frac{a_2}{1+i} + \frac{a_3}{(1+i)^2} + \dots + \frac{a_n}{(1+i)^{(n-1)}}$$

⁵ *The Theory of Interest*, App. No. 3 to Chap. XIII, p. 514. Cf. also, K. E. Boulding, "The Theory of a Single Investment," *Quarterly Journal of Economics*, May, 1935, p. 478, and Samuelson, P. A., *op. cit.*, p. 470. Mr. Samuelson's article makes use of the calculus to present this and the other principles set out in this chapter, and includes several refinements not possible without the use of such mathematics.

3. MAXIMIZING THE VALUE OF CAPITAL.

It is our contention that the objective of business action is to increase the value of capital. That this is so must be clear from the discussion with which this chapter opened. The attainment of this objective involves, among other things, the question of the appropriate rate of interest to be used in discounting, for it is clear that different rates of discount will give different values, and it is not obvious that the "market" rate—or any other specific rate—is most appropriately used. It is still best to avoid this question, however, and first to discuss the problem of maximizing the value of an investment when we assume the most appropriate rate to be chosen.

If we grant this, then again the principle is simple: a business man will wish to choose that one among the various income streams open to him which has the highest present value. He can do so by adjusting his plan of investment so that no possibilities remain whereby a decrease in net income in any one year can secure an increase in income in some other year such that, when both are discounted to the time of valuation (the "present"), the increase is greater than the decrease. We may, that is, conceive of business men engaged in the comparison of different plans of action. Should more be spent in a certain year for plant, materials, renovation, etc., etc.: this will reduce net income during the year in question. It will cause net income to increase some time later. Is the sacrifice worth the gain (or gains; for these may be distributed over a number of accounting periods)? The answer depends on the relative values of the gains and losses when these have been discounted back to the present. If the change involved is one of a decrease in income in a relatively early year followed by later increases in income, we might say that the change of plan was justified so long as the later increases in income discounted back to the time when the expense is incurred are greater than the outgo in question.

In terms of the formula (1) presented above, what is re-

quired is that the first differential quotient of this equation shall be zero.⁶

Thus:

$$(3) \quad dV = da_1 + \frac{da_2}{1+i} + \frac{da_3}{(1+i)(1+i_2)} + \dots + \frac{da_n}{(1+i)(1+i_2)\dots(1+i_{n-1})} = 0$$

We may express the same condition in marginal productivity terms. If we refer to any small decrease in net income in a given year as the marginal cost of input and to the associated increases of net income as the marginal product of input, then our condition is that the value of the business man's capital is maximized when the marginal cost of input in any period is equal to the associated marginal product of that input when both are discounted back to the present.

We have spoken of "input", to this point, as a general category covering all additional expenditures which cause the net income of a period to be smaller. But, of course, this general category may be broken down into expenditures on labor of various grades, or machinery of different kinds, or raw materials, and so on. No additional argument is necessary to make it clear that, in so far as one is able to trace results to causes, the marginal productivity condition laid down above applies with equal strength to each sub-category of input. Expenditures on each grade and class of input should be carried to the point at which the sum of its discounted marginal products equals the marginal cost of input.⁷

⁶ Cf. Fisher, *op. cit.*, App. 3 to Ch. XIII, p. 514.

⁷ It is well to stress here the generality of the argument. The effect of a given expenditure which is incurred on a given date may be spread over many periods. It is the *sum* of these effects, discounted, which must be equated with the additional input. Moreover, input (say, of labor) may have a marginal product in periods before it is applied, for output in any period may be increased by allowing equipment to deteriorate. This deterioration could be made good later. The product then is secured before the expenditure. Now the marginal product of the labor *accumulated* to the time when the labor is applied must equal the marginal cost of the labor. (Cf. Hicks, J. R., "Wages and Interest, The Dynamic Problem," *Economic Journal*, vol. 45, p. 461, fn.)

4. THE APPROPRIATE RATE OF DISCOUNT, WHEN UNCERTAINTY IS ABSENT.

We come now to the final aspect of the business man's problem of laying his plans in such a fashion as to make the most of his opportunities. It is easy to show that the rates of interest selected to discount future outlay and receipts can make tremendous differences in the present value of two investments. In general, the further off is the occurrence of any income item, the less is its present value. It follows that if an investment, A, promises large returns at relatively distant times and low returns in the near future, its present value will be lower than another investment, B, which promises to yield the same returns in reverse order, provided the same rate of interest is used. This disadvantage could be overcome if the size of A's income items were larger than those of B. Two such investments then may be imagined which, discounted at the same rate, would have the same present value. Now if a lower interest rate should be chosen, A would be preferred to B, for the more distant items now receive greater weight relative to the less distant ones. The reverse would be true if a higher rate were used in discounting.

What rate, or rates, of interest should a business use? ⁸ Our guiding principle throughout is, of course, that the value of the investment to the *owner* should be as large as possible. From this it would seem to follow that an investor should apply to every income item that rate which would serve to equalize the value of additional income to him in the present with that of additional income in the future.

This, however, would be true only if the investor were debarred from the advantages of a loan market, for then the only method by which a man could alter the time-distribution of his income would be by an adjustment of his business plans. Our present assumption, however, is that a business man has access

⁸ The income of different periods may, of course, be discounted at different rates.

to a perfect loan market, in which all may borrow and lend in unlimited amounts at the going rate of interest. This rate will be different for loans of different length, but it will be perfectly definite for every period.

In this ideal situation it can be shown that it is the application of market-rates of interest which enables a business man to choose that investment which is of greatest value to him.⁹ The central principle in our argument is the self-evident fact that if one investment yields a larger return on every given date than a second, the first is to be preferred to the second.

Our argument would proceed in the following manner. Let a man capitalize the income items from two alternative plans of investment by applying the market-rates of interest. Let investment A prove to have the greater present value on this basis. But let us suppose the investor to prefer the time-distribution of income associated with investment according to Plan B.

Now given a loan market of the type assumed, it can be shown that A is preferable to B. By suitable loans and borrowings, the investor can change the shape of the income stream secured to any desired shape. That is, in any year income will be the income from A — loans or + borrowings, or income from A — repayments on account of past borrowing or + repayments on account of past lending. He may, therefore, make it identical with the time-shape of B. Now it follows from the fact that all the loan transactions are concluded at the market rates of interest, which is the rate used in capitalizing (by hypothesis), that the present value of the total position according to Plan A has not changed. But if income from Plan A has the same time-distribution as that from Plan B and a greater value, this can only be because it offers a larger income on every date than does B. Therefore, it would be preferred by the investor. And since the use of the market rate thus enables him, in the assumed situation, to choose correctly between alternative

⁹ Cf. I. Fisher, *op. cit.*

plans of investment, the market-rate of interest is the one most appropriate to use.¹⁰

It is from this fact, that the market-rate of interest will be used by investors in choosing between alternative plans, that we may deduce the proposition that in the assumed conditions of perfect knowledge, etc., the *market-value* of an investment will be the sum of its income items, each discounted to the present at the market-rate of interest. No owner of an investment will take less, for he could in these ideal circumstances arrange a series of loans and borrowing which would furnish him an income of the same size as a money sum equivalent to the value of his capital would buy in the market. No prospective purchaser would offer more, for he could with the same sum arrange his loans to the market in such a way as to secure a series of income items of the same size and shape as that which the investment in question offers.¹¹

A word may be added at this point concerning the relation between short-term and long-term rates of interest under the conditions assumed to be present in the loan-market. If borrowers and lenders have perfect foresight with respect to the interest rates which will rule in the future, the rate for loans

¹⁰ The fact that there may be a different market rate in effect for loans of different maturity does not affect the issue at all. For the investor will find it most appropriate to discount any given income item by that rate which rules in the market for loans whose maturity date is the same as that of the occurrence of the given income item. Thus none of the relations set out above are disturbed.

¹¹ Mr. Paul Samuelson, *op. cit.*, p. 482, supports the same conclusion by an argument which appears to be open to attack. He asserts that an entrepreneur will capitalize items of future incomes at the market rate of interest because "under our ideal conditions, the investment account necessarily has a market value equal to the capitalized value, and is equivalent to an equal money sum, and a larger initial sum of money is always to be preferred to a smaller one." (Mr. Samuelson's italics.) The italicized statement is true, but as it stands, it assumes away the question. The capitalized value and the market value are the same only because, *under the ideal conditions assumed*, business men find it best to use the market-rate in capitalizing investments. And they use the market-rate because of the possibility of changing the time-shape of any income stream to an unlimited degree through the use of the loan market.

of any given maturity must be equal to the product of the rates foreseen to apply to a series of shorter-term loans covering the same period of time. No other relation would be possible; for if the rate on ten-year loans, for example, were greater than the product of the rates on a series of ten one-year loans, it would pay to lend indefinitely large amounts on a ten-year basis, borrowing the necessary funds by a series of one-year loans. This, however, would force up short-time rates and force down long-time rates. The reverse operation would take place if the long-rate were lower than the product of the rates on a series of short loans over the same period.¹²

It was pointed out above, p. 74, fn. 10, however, that the existence of different rates of interest for loans of different maturities did not alter the principle that, in the conditions assumed, future income was to be discounted by the market rate of interest. The appropriate rate for discounting income x years in the future is the market rate for a loan of x years' maturity. And in the conditions under view this is unambiguous, for the interest charges on a series of short-term loans covering the same period would be the same as the rate for a single long-term loan.

¹² Since this was written, F. R. Macaulay has published his illuminating monograph, *Bond Yields, Interest Rates and Stock Prices* (New York, 1938). Chapter II of this work treats the relation between long-term and short-term rates *in extenso*.

CHAPTER IV

THE ANALYSIS OF INVESTMENT DECISIONS: II

THE EFFECTS OF UNCERTAINTIES UPON BUSINESS-PLANNING

I. INTRODUCTION.

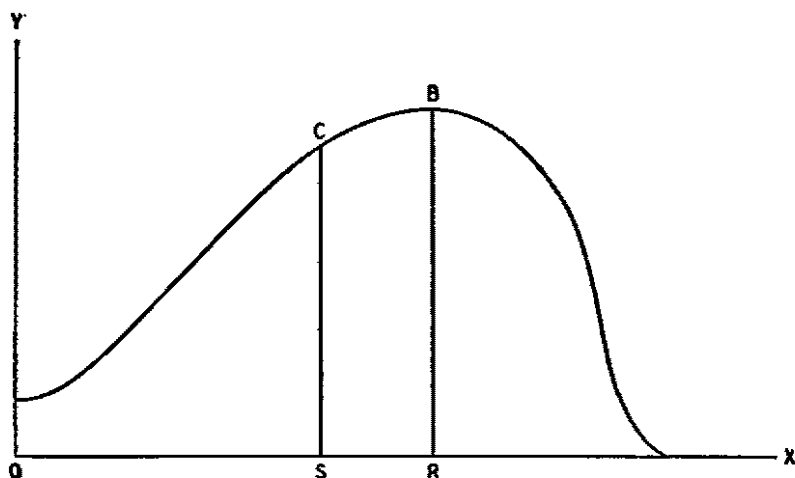
The preceding chapter introduced the analysis of investment decisions by considering a specially simplified case. In this chapter, we may proceed to grapple with the problem on a less abstract level. Instead of assuming that an investment decision involves a foreknown series of income items, we shall recognize that a firm faces a number of alternative plans in which the amount and distribution of future costs and receipts is uncertain. In addition, we must recognize that the loan market is not the idealized institution of the last chapter. It differs from that version in two ways. In the first place, the rates of interest which will rule in the future are uncertain, although current rates are quoted for various time periods. In the second place, the payment of interest and the repayment of principal are uncertain. As a result, we can no longer assume a single rate of interest for every maturity at which all can borrow and lend in unlimited amounts. But these two characteristics of the real loan-market have consequences which ought not to be confused. First, therefore, it will be assumed that future rates of interest are uncertain, but that there are no risks of non-payment of interest or principal. In consequence, all firms, since they are small relative to the loan-market, are supposed to be able to borrow and lend in unlimited amounts at whatever interest rates, are quoted for whatever period.

2. THE RESULTS OF UNCERTAINTY ABOUT INCOME

We may best conceive of the income of a certain future period in the fashion in which a business man conceives it. He has made certain expenditures in the past which have

secured for him certain assets. Given these, he estimates what his receipts will probably be in the future if he manages his business as wisely as he can; he also estimates what expenses he will most probably incur. A firm also considers in some rough fashion the possibility that costs and receipts will be of other sizes. These alternative possibilities must have certain rough weights attached to them in the minds of business men. It may seem to put too definite a form upon this picture of a business man's conception of the future income from his business if we interpreted this conception as a probability distribution. But this is only to say that a business man considers that the future holds a number of alternative possibilities each more or less certain.¹

¹ The firm's estimates may be conceived of in the form of a curve such as the following:



Along OX mark off all the possible receipts to be secured in a certain period from a certain previous expenditure. Now draw a curve such that the area under it, between any two points on OX, represents the probability of a return between the two corresponding values. From such a distribution of probabilities, we may readily find the neighboring values between which returns are most probable. The probability of such returns is represented by the ordinate RB above. And it is also easy to compute the "actuarial value" of the chances of the receipts indicated on the curve. This will be the mean

The modal point of such a distribution is that which a business man would think of as the most probable size of receipts consequent upon a given expenditure. In a rough way too, he will estimate the "actuarial value", or the mean value, of the entire set of possibilities. This will be referred to below as the "rough mathematical value" of the chances.

At this point, we must recognize a certain difficulty. The possibilities with respect to costs and those with respect to receipts will not be independent in the mind of a business man, except in exceptional circumstances. Generally he will assume that selling-prices and cost-prices do not move independently of one another. He will, therefore, estimate the chances of being involved in costs of various amounts only in conjunction with an hypothesis with respect to receipts. There will, therefore, be a large number of rough probability distributions of costs. The number obviously depends on the number of different hypotheses with respect to receipts which the firm thinks it necessary to make. From these data, in some rough fashion, a firm will make its estimate of the combined chances of being involved in costs of various sizes. From this distribution again, there can be found a "most probable" and an "actuarial" value.

These two sets of estimates, the chances of receipts over a certain period and the chances of costs, will be used to compute a rough estimate of the chances which attach to the various possibilities of net income of different sizes, the "most probable" size of the net income and the rough mathematical value of the entire set of possibilities.²

of the distribution, SC above, computed in the ordinary fashion. Since a firm's estimates are, in the nature of the case, very rough, we shall call this the "rough mathematical value" of the chances of receipts. Cf. Pigou, A. C., *Economics of Welfare*, App. III on "Uncertainty-Bearing."

2 If a firm wished to attach precise numerical values to its rough estimates of the probability of different net incomes, it could adopt the following procedure:

(1) Estimate the probabilities of securing gross receipts of various sizes

A plan of investment will then carry with it a series of figures for net income which represents the firm's best estimate of the rough mathematical value of the set of possibilities afforded by each period. This, however, does not necessarily represent the value of this set of possibilities to a firm, and in general its (undiscounted) value will be something other. The difference is due to the fact that people do not, in general, treat as equivalent a given income conceived to be certain and a *set of possibilities* whose rough mathematical value is the same figure. The first is a definite prospect. To the second an aura of uncertainty attaches.

A rough measure of this estimated uncertainty is afforded by any of the common methods for measuring the deviation of a distribution from its mean value. Now the extent to which the rough mathematical value of the set of possibilities will be altered, given the estimated deviation of the possibilities from the mean, depends upon the attitude of a particular firm towards a situation marked by such uncertainty. For a few firms, the existence of such uncertainty will be a fact of positive value. For most, it is a disagreeable incident of business, and these firms will then consider a future set of possibilities as less valuable than its rough mathematical value.

over a period if the firm adopts a certain plan of operations, by using whatever data the firm considers relevant.

(2) Upon different hypotheses as to gross receipts, estimate the chances of being involved in costs of various amounts over the period in question.

(3) Net income is the difference between the gross receipts and gross outgo for a period. The probability of getting any particular net income is then the sum of the probabilities of all the various combinations of costs and receipts which would give the particular net income.

(4) To secure the probability of getting any specified net income by a particular combination of costs and receipts, multiply the probability of securing the receipts by that value which expresses the probability of being involved in the specified costs, the latter estimated on the hypothesis that the specified receipts are secured.

(5) Repeat this operation for every other combination of receipts and costs which gives the same net income; and sum the probability ratios thus secured. The sum is the total probability of securing the particular net income.

(6) Repeat these operations for every other value of net income of interest to the firm.

We may say then that a firm applies a "caution factor" (to adopt Prof. Fisher's term) to its estimate of the rough mathematical value of the future prospects for net income over a given period. The size of this correction depends upon its estimate of the uncertainty attaching to the investment (measured roughly as described above) and upon its attitude toward bearing the degree of uncertainty so estimated.³

It is this series of roughly discounted and estimated income items whose present value to the firm must be made as great as possible. Let us proceed to consider the process by which a firm adopts the plan it values most highly by first thinking only of an abstract rate of interest to be used in discounting future income. This will be called "the appropriate rate of discount." Later sections of this chapter will be devoted to a discussion of the rate of discount which is appropriate in various circumstances.

A firm will then proceed in the following manner. It will think of alternative production plans as involving it in various possibilities of future costs which offer various possibilities of future receipts. This will allow it to estimate the probabilities of future net income attaching to alternative plans. Additions

³ See: I. Fisher, *op. cit.*, Chap. XVI and Appendix to Chap. XVI; and A. C. Pigou, *Economics of Welfare*, IV Ed., Appendix I on "Uncertainty-Bearing as a Factor of Production."

Dr. A. G. Hart, in his pioneering article, "Anticipations, Business Planning, and the Cycle" (*Quarterly Journal of Economics*, February, 1937), appears to take a contrary stand. On page 289, he writes: . . . "Uncertain returns are sometimes spoken of as 'discounted' not only for futurity but for uncertainty. This implies that returns in each possible contingency are given a separate present value (less than the gross value not only because they are future but because they may not happen). But in embarking on any particular policy the entrepreneur assumes not the chance of getting a certain amount or nothing but a cluster of contingent opportunities which must be valued as a whole. If all contingencies are taken into account and given probability values, no further 'discounting' is called for except for futurity." On another page, however, Dr. Hart refers to 'antipathy to risk' (p. 291).

The answer to this position is not logic, but observation. People do not in fact treat as equivalent the mathematical value of the set of contingencies envisaged and an equal value conceived to be certain.

to costs in certain years or other periods will promise larger receipts (generally) in the future. It will be planned to incur additional costs whenever the sum of the estimated resultant receipts envisioned as having a certain probability of occurring, and appropriately discounted to the present, is greater than the additional costs to be incurred (likewise envisioned as probable rather than certain) and appropriately discounted to the present. We have once more the condition that the firm anticipates that the appropriately discounted differential cost of input (the rough mathematical value of the possibilities of costs, discounted for uncertainty) be equal to the appropriately discounted anticipated differential receipts from input (similarly interpreted). When all such possibilities of adjustment of plan have been exhausted, the firm will have brought the present value of its anticipated future income to a point as high as possible in its own estimation.⁴

3. FURTHER DISCUSSION OF INVESTMENT PLANS FOR AN UNCERTAIN FUTURE: THE PROVISION OF FLEXIBILITY IN PLANS.

We have argued above that the aura of uncertainty which attaches to a certain rough mathematical expectation of net income generally reduces its value to a firm. This fact urges the necessity for a firm of choosing between plans which offer a higher but less certain expectation of net income and lower but more certain expectations.⁵ One of the important forms in which this choice presents itself is that of two alternatives of which one is marked by a relatively low degree of flexibility, and the other by a relatively high degree of flexibility. One plan will involve a relatively large expenditure for (say) specialized equipment, the other a smaller expenditure for such

⁴ It will be shown later that one element of value to a firm is to increase the value of the firm in the estimation of others. And this may involve plans which are not the same as those which would be adopted if outside opinion were disregarded.

⁵ The test, mathematically conceived, is the dispersion of probabilities about the mean.

equipment. The first plan will be more efficient if all occurs much as was anticipated, but it will be relatively expensive if demand fails to measure up to expectations. The other plan will be less efficient at best, but not so dangerous a burden if expected events fail to occur.

This example is typical of the decisions which firms must make in choosing between income and safety. Expenditure for research and for inventory in certain circumstances, the holding of idle cash balances, the production of relatively staple products, or of a varied line, all are means to reduce uncertainty, which involve relatively high costs if all goes well, and relatively low costs when the unexpected occurs. Firms strike a balance between the two alternatives in accordance with their subjective attitude towards risk.⁶ In the terms we have used above, the plans involving less uncertainty will be preferred up to the point at which the increase in present value because of a reduction of uncertainty equals the decrease in present value because of a reduction in the rough mathematical expectations of net income.

It is now time to turn to a discussion of the rates of discount which are appropriately applied to future costs and receipts.

4. THE EFFECT OF UNCERTAINTY WITH RESPECT TO INTEREST-RATES—A

It was explained above that the element of uncertainty in the loan market has two aspects. People are uncertain about the rates of interest which will rule in the future—although rates are currently quoted for various time periods—and people are uncertain about the payment of interest and principal. The effect of the first aspect of uncertainty may be isolated by assuming that the payment of contractual interest and the repayment of principal is certain.⁷

⁶ Cf. A. G. Hart, *op. cit.*, pp. 286-291, and C. O. Hardy, *Risk and Risk-Bearing*, U. of Chicago Press, 1923.

⁷ This assumption may be rendered realistic by supposing that borrowers are able to deposit collateral security which affords so wide a margin of safety as to reduce the danger of loss to lenders to a negligible quantity.

The effect of our assumption is to retain for this section the condition in which all business men can lend and borrow in unlimited amounts at the rates which rule for loans of various maturities.

(1) It must first be noticed that the relation between rates for short-term and long-term loans is different from that which would rule in a situation marked by complete foresight. It was shown above⁸ that if all borrowers and lenders had complete foresight, the rate for loans of any given maturity must necessarily be equal to the product of the short-term rates foreseen as current over the intervening period between the date a loan is contracted and its maturity. Any other relation would be impossible, for a discrepancy would afford foreseen opportunities for certain profit; and the action of the market would then remove the difference.

The situation is otherwise when the future is uncertain. But the relation to which rates must tend may be stated. Every business man will see a chance to profit by borrowing and lending whenever the rate of interest on loans for a certain period is other than the product of intervening short-term rates which they expect to rule. If the long-term rate be higher than this product, they will loan money on long-term and plan to cover their needs by borrowing on short-term. On the other hand if the long-rate be less than this product of expected rates, they will borrow on long-term and plan to lend on short-term.

Now, however, there is no obvious need for the situation to reach a position of stability in the volume of loans. For if there be disagreement as to the course of future interest rates, then some members of the market may feel it profitable to borrow on long-term and lend on short, while others may consider it profitable to fill the needs of the first set. Indeed, but one heretical prophet of the future seems necessary to force us to draw a picture of a money market pyramiding loans to a volume without limit. Nothing could then be said about the rates of interest which would rule.

⁸ See p. 74, above.

From this hyper-excited market we are saved by the increasing weight, in these operations, of the burden of uncertainty. Each speculator in this market is gambling on an uncertain future. The "rough mathematical estimate" of future interest-rates to which he holds may point to the likelihood of profit. But he recognizes the possibility of other outcomes; and their presence causes him to value the expected future profits at less than their rough mathematical value. He discounts these possibilities by a "caution factor".⁹ This may still leave a man a margin of profit when he commences his speculative moves. But as he increases the size of his wager on a certain outcome, the caution factor must become greater and greater. This follows of necessity, at least for most people, from the fact that the estimated utility of additional profits, if secured, must become smaller and the estimated utility of additional losses, if suffered, greater as the profits or losses to be made increase. Every speculator, therefore, must finally reach a point at which the rough mathematical estimate of likely gain when corrected for uncertainty no longer offers him an incentive to further borrowing or lending.

The conclusion, therefore, must be that the rates on loans for every maturity must tend to stand at a level equal to the rough mathematical value, corrected for uncertainty, which each person attaches to the product of the interest rates he expects to rule over intervening periods. These expectations discounted for caution may differ in detail for each individual, but their net product must be equal.¹⁰

⁹ See above, p. 80.

¹⁰ Thus:

Let i = the rate of interest currently quoted for 10-year loans

r_1 = current rate for one-year loans

r'_1 = the expectation of individual A of the one-year rate which will rule a year hence

r'_2 = the same two years hence

.

.

.

(2) It is now possible to discuss what rate of discount a firm will find appropriate for reducing to present value its prospects of future income when the firm is engaged in ordering its production plan. A solution of this question, adequate under the assumptions, was presented in Chapter III. It is necessary now to discover a more general formula under which the case of Chapter III will stand as a special case.

The basic principle from which the general formula can be derived is this: It is always worthwhile to lend or invest so long as the expected increases in future income thus secured are equal to the amounts invested when the increases are discounted back to the time of investment by a rate equal to the investor's "marginal rate of time-preference."

Given one's psychological constitution, one's preference for income in any year as compared with income in any other year is a function of expected income in the years in question. We may then define "marginal rate of time-preference" in Professor Fisher's fashion as follows:¹¹

$$f_1 = \frac{w' - w''}{w''}$$

where f_1 = marginal rate of time preference for this year's income over next year's income

$$w' = \frac{d W_1}{d X_1}, \text{ where } W_1 = \text{utility of this year's income} \\ \text{and } X_1 = \text{amount of this year's income}$$

$$w'' = \frac{d W_2}{d X_2}, \text{ where } W_2 \text{ and } X_2 \text{ are corresponding items} \\ \text{for utility and income of next year as} \\ \text{expected this year.}$$

r'_{10} = the same nine years hence

C' = the caution factor of Individual A

Then A will continue his speculative operations until:

$$i = C' (1 + r'_1) (1 + r'_2) (1 + r'_3) \dots (1 + r'_{10}).$$

Every other individual must finally apply a caution factor such that whatever the values he gives to the (r) rates their product, multiplied by C , = i .

11 *Op. cit.*, Appendix to Chap. XII, § 1, p. 510.

Analogous formulas may easily be constructed to define the marginal rate of time-preference for the income of any year over the income of any other year. The W 's and X 's must then be uniformly interpreted as the rough mathematical expectation of the utility of income and of the size of income, corrected by a caution-factor.

Whenever a person has access to a loan market, this fact puts limits to his expected marginal rate of time-preference. It is possible to say this: that one's expected marginal rate of time-preference for income in any year as compared with another cannot exceed the expected marginal cost of borrowing for the term intervening between the first year and the second. For if one's rate of time-preference be greater, it will pay to transfer income from the second year to the first by negotiating loans, and so to reduce one's desire for additional income in the earlier year. The limit is reached when the additional satisfaction thus secured is matched by the discounted value of the satisfaction which it is estimated will be lost by interest payments and repayment of principal. On the other hand, one's marginal rate of time-preference cannot be less than the anticipated marginal receipts from lending (provided these be less than or equal to the marginal cost of borrowing). For if it be less, it will pay to increase income in later years by lending until the additional value of the satisfaction which it is estimated will be gained discounted back to the year of lending by the marginal rate of time-preference is equal to that which it is expected will be lost.¹²

From these considerations, it is now possible to see again why, in the perfect loan market of Chapter II, the market-rates of interest were applied in discounting. The possibility of both borrowing and lending in unlimited amounts at these rates, together with the fact that rates for loans of any length current at any time necessarily were equal to the product of foreseen short-term rates to rule in the future, made it impossible for

¹² The marginal rate of time-preference will now, of course, be rising as income in the earlier year is reduced by lending.

marginal rates of time-preference as between different periods to be other than the rates of interest current on loans over the intervening time.

The application of this principle to our present assumptions may now be attempted. It will be remembered that the effect of our current assumptions is to establish two conditions for the loan market. In the first place, it is possible for every firm to borrow and lend in unlimited amounts at any ruling rate of interest. But, secondly, because the future is uncertain, it is possible to plan to borrow for a relatively long term at one rate and to relend the money with profit at short-term over the period of the long loan—or the reverse.

The matter can now be stated quite generally. We shall find that for the assumptions now made, our conclusions are not seriously changed. Let us consider the question whether it pays to plan to increase one's investment in some future period, the returns to be secured in some later period. The time intervening will here be called the *investment period*. Three possibilities can now be envisaged. Either the firm expects that the rate of interest on a loan for the entire period will be the same as the product of the short-term rates which it expects to rule over the investment period, or it expects that the long-rate will be greater than this product, or finally less.

In the first case, the expected long-rate will be applied in discounting, for reasons identical with those adduced for the argument of Chapter III.

In the second case, the firm's marginal rate of time-preference finds its maximum, when the process of planning commences, in the firm's rough mathematical estimate of the product of short-time rates of interest (corrected for caution) which it expects to rule over the investment period. Since it can lend at these or higher rates, these expectations also furnish a minimum for its rate of time-preference. It then regards its business opportunities and the long-term loan market as alternative investment opportunities; and it will first take whichever promises the higher returns. As it extends its planned invest-

ments, the caution factor which it applies to its expectation of future interest rates acts to bring up their anticipated value. These rising discount rates act to reduce the estimated gain from investment. But the discount factor cannot rise to a point above the current long-time rate, for when it reaches a level equal to it, the firm can provide for its financial needs at this rate.

It is possible to say, then, that the discount factor in this case is, for intra-marginal investments, an estimated product of short-term rates which rises as investment increases. On the margin, the product of these estimated rates is valued at a level equivalent to the current long-term rate, and this may then be considered the factor of discount.

In the third case, the firm will discount its investment and lending opportunities at the rate for loans of the length of the investment period, choosing to extend their business investments or their loans to the short-term money market, whichever offers the higher returns. But if it first choose the short market, it will find its opportunities there are limited by an increasing caution factor which will gradually reduce and finally remove the value of the firm's expectations of gain from such operations. At some point, it will become profitable to exploit their business opportunities valuing these by discount at the current long-term rate. The value of the firm's income will not be as great as it may be until its rough mathematical estimate of the increase in income from such investments, discounted for uncertainty and rendered comparable with the cost of investment by discounting by the long-term rate for loans over the investment period, is equal to the differential cost of investment at the time when the cost is expected to be incurred.

This discussion may now be put in summary form. (a) We must think of business men as making rough mathematical estimates of the value of future income. This estimate is given something other than full value in view of the attitude of a firm towards uncertainty-bearing. (b) Uncertainty in the loan market, of the type considered, affords an additional investment

opportunity to business men by making it possible to profit either by lending on long term and borrowing on short term or by the opposite operation, depending upon the individual anticipations of business men. (c) The consequence of this fact is that, for certain intra-marginal investments, the discount factor is not a currently quoted rate, but an anticipated product of future interest rates. Even in these cases, however, the discount factor on the margin is a factor equivalent to the current rate quoted on loans of maturity equal to the duration of the investment or loan in question.

5. THE EFFECT OF UNCERTAINTY WITH RESPECT TO INTEREST RATES—B

(1) It is time now to introduce the second aspect of uncertainty in the loan-market which has, to this point, been disregarded. This aspect of uncertainty arises from the fact that it is not possible to regard the payment of interest and the repayment of principal as completely certain.

Insecurity from this cause is conceived by lenders to be dependent upon (a) their knowledge of the character of the borrowers, (b) the resources of the borrowers, both those specifically pledged as security and those unpledged, (c) the investments to which the loans are likely to be committed (this is an aspect of (b)), (d) the length of time for which the loan is to run, and (e) the size of the loan in question.

This conception of the basis of insecurity in lending has several consequences for the character of the loan-market. In the first place, it is no longer possible to speak of "market-rates" of interest. Rates of interest are personal to every borrower¹³ and vary from firm to firm according to circumstances. Secondly, as a corollary to the first point, it is usually not possible for firms both to lend and to borrow at the same

¹³ This puts the case perhaps too strongly. But even if one can distinguish different classes of borrowers and lenders for whose members approximately the same nominal interest rates apply, nevertheless special terms and conditions, as in the handling of collateral, often create real differences in terms which are not to be disregarded.

rates of interest. Indeed, the nominal rates of interest cease to have much meaning since the payment of interest is more or less uncertain.

Thirdly, the rates of interest at which firms can borrow are not independent of the size of their borrowings, but generally rise as the amount of their debts increases. It is characteristic of the loan market that after a point it is impossible for a firm to secure further loans on any practicable terms.

Finally, it is necessary to distinguish between costs of borrowing and receipts from lending, in so far as they are affected with uncertainty of the type now discussed. In the eyes of a borrower, the terms of his contract impose a certain obligation concerning which he has, practically speaking, no doubts. In the eyes of the lender, the face of the contract affords him only a *chance* of securing the nominal interest and principal. Thus the costs of borrowing are not in ordinary circumstances¹⁴ subject to discount for uncertainty of this variety, but the expected receipts from lending have only a rough mathematical value, which is not quite the same as the face of the contract. This is further altered by the application of a caution factor, in accordance with the attitude of a lender towards uncertainty-bearing. It is this net resultant which constitutes the estimated receipts from lending.

(2) These additional complications must now be worked into our discussions of the rate appropriate in discounting. It is necessary, however, to digress briefly to consider the relation between relatively long-term rates of interest in the loan market and relatively short-term rates, and the opportunities for profitable speculation which, in part, determines these relations.

The opportunities for profitable speculation when payment of interest and principal were considered certain were found to be limited only by a rising caution factor applied to anticipated value of the product of short-term rates of interest. A person's inducement to continue speculation in this market was thus exhausted when the rate at which he could borrow (or lend) at

¹⁴ Except in the contingency of bankruptcy.

long-term for a period was equal to his rough mathematical estimate of the product of short-term rates at which he hoped to be able to lend (or borrow) over the period, corrected for uncertainty. And this fact was used to define the relation between short- and long rates.¹⁵

Under our present assumptions, a second factor enters to limit profitable speculation in short- and long-term loans. This factor is the rising cost of borrowing. The rate at which an individual can lend is generally not affected by his own operations. But the rate at which he can borrow generally is so affected. The limit to speculation, is, therefore, found for each person when the marginal cost of borrowing¹⁶ at long-term is for him equal to his estimate of the product of the interim rates at which he hopes to be able to lend at short-term. Or, if he expects the product of short-term rates to be lower than the current long-rate, then the reverse.

(3) It is now possible to apply the considerations of the discussion above to the problem of the rate to be used in discounting future income.

The general principles have already been laid down. In brief, the discount factor to be applied to a marginal increment of investment is always the investor's marginal rate of time-preference. But this marginal rate of time-preference cannot exceed the expected marginal cost of borrowing. It may, however, be less than the marginal cost of borrowing if the expected marginal receipts from lending¹⁷ are lower.¹⁸ In this case the ex-

15 In short, any level of currently quoted relatively short-rates is consistent with any level of currently-quoted, relatively long-rates if the anticipations of business men and their attitudes toward uncertainty are undefined. The relation between long- and short-rates can only be made definite by defining these subjective characteristics of business men.

16 The marginal cost of borrowing may or may not be greater than the rate at which a person can secure an incremental credit. It is, if the increment of borrowing causes the rate on his general line of credit to rise. Otherwise not. In any case, the rate of interest for *additional* loans will be rising.

17 *I. e.*, the rough mathematical estimate of these receipts, discounted for uncertainty.

18 Which might be the case for a firm which uncommitted cash.

pected receipts from lending afford a minimum below which marginal rates of time-preference will not fall. The marginal cost of borrowing which is relevant may be either that for borrowing at long-term, or that for borrowing at short-term. The business man will choose whichever promises the lower total cost when discounted to the present. Similarly the expected receipts from lending which apply are always those for lending at long or short-term, whichever is greater.

For industrial firms, it will usually be true that the rates at which they can borrow or expect to be able to borrow are higher than the rates at which they can lend or expect to be able to lend. In this case, while the appropriate rate of discount (= marginal rate of time-preference) can be no longer than the firm's expected marginal receipts from lending and no higher than the estimated marginal cost of borrowing, it may often lie between. This may sometimes be an important consideration. It is so for firms with surplus cash at times when lenders are so wary of giving credit that market rates of interest are high.¹⁹ As such a firm extends its investments, its marginal rate of time-preference will rise and finally would become equal to the marginal cost of borrowing to the firm and again this rate would become the appropriate rate of discount.

As investment is pushed further, both the rate of time-preference and the marginal cost of borrowing will usually rise.²⁰ The former cannot rise more rapidly than the latter, but the reverse may be true; indeed a firm may completely exhaust its credit. In this event, the expected income from increased

¹⁹ If these rates are not expected to remain high, the case loses most of its point. High current interest rates are, of course, not the same as high expected receipts from lending if lenders consider the risk great.

²⁰ It is possible that as the investments of some firms increase, the cost of borrowing will decline. But this is unlikely to be the case if the firm's investments are growing solely on the basis of borrowings. If, however, the cost of borrowing declines because the members of the firm contribute additional assets of their own, this does not indicate a declining supply curve of loans to the firm. It indicates that the increase in the firm's equity account has caused the supply curve of loans to it to shift downward.

investment is most appropriately discounted by the firm's marginal rate of time-preference.²¹

6. THE EFFECT OF SELLING-VALUE OF A FIRM UPON INVESTMENT PLANS

If both the owners of a firm and every prospective purchaser had complete knowledge of future prospects with respect to the income from investments and if the loan-market were characterized by the conditions assumed in Chapter III,²² the plan of investments which maximized the value of the income stream to a firm would also make the firm's selling value as great as possible. But if these conditions do not obtain, then the plan of investment which maximized the value of the income stream may not, probably would not, be the plan which made selling-value as great as possible. For people are likely to disagree as to the incomes offered by different plans of investment; they will have different views of the risks involved, different attitudes toward risk-bearing, and the rates at which they discount the future will, in general, be different.

In this event, a firm may pursue one of two policies. It may regard the problem of selling-out as too remote a contingency to consider in making its investment plans. In that event, it will best follow the scheme presented in the preceding discussion. If, however, the possibility of liquidating on favorable terms is a matter of interest to a firm,²³ then one element of value in a firm's estimates of the prospects of an investment is its notion of the value which prospective purchasers would put on the plan. This may often cause firms to adopt investment plans which they would not adopt in precisely the same form if its own estimates of income-yielding possibilities were alone in the balance.

²¹ The funds can be secured from current profits, the failure adequately to maintain equipment, the contributions of members of the firm, etc.

²² See p. 68, above.

²³ A firm may be interested in the possibility of liquidation either as an additional measure of safety or as a means of securing capital of greater value to itself than it otherwise could secure.

CHAPTER V

COSTS AND RECEIPTS AS DETERMINANTS OF DECISIONS TO INVEST

I. INTRODUCTION.

The last two chapters presented in the most general fashion the factors bearing on investment decisions. Details were presented only with respect to the choice of the discount factor and the influence of uncertainties. It will be the purpose of this chapter to examine in greater detail the incentives and deterrents to investment on the side of income. We shall not say more of the question of uncertainty but by our use of the phrase "expected income" or "receipts" or "costs" there must be understood the full connotation of "the rough mathematical expectation of income, corrected for uncertainty."

Investment takes three forms: an increase of inventory of finished or unfinished goods, an increase of the rate of production (that is, in the rate at which goods are being moved to completion)¹ and an increase of equipment.

The main principle governing decisions to invest is, as shown above, to make the differential cost of investment equal to the differential receipts due to investment, both discounted to a common date. This is, of course, the same as saying that the differential decrease in expected income is made equal to the differential increase in expected income appropriately discounted. But the components of the costs and receipts categories are complicated, and it will clarify our notions to consider the matter for the three classes of investments set up above. By "differential cost" we must understand: all the unfavorable aspects of an investment decision, and by "differential receipts" all the favorable aspects of an investment decision. Thus costs comprise both increases in outpayments necessitated

¹ This involves an increase in the value of inventory unless goods are sold at such a rate as to offset the effects of the additional processing.

and decreases in the inflow of money while receipts comprise both increases in the inflow of money and decreases in outpayments.

In this and in the following chapter, we shall deal with the problem of a single firm; in Chapter VII, the problem of an industry will be considered.

2. INVESTMENTS IN INVENTORY

By an investment in inventory, we mean a decision to postpone the sale of finished goods or the completion of unfinished goods, or a decision to purchase raw materials, not for current production, but for future production. The simplest set of alternatives is offered the entrepreneur by the case of completely finished goods, for here there is no need to take into account any costs of production. In this case, the costs of investment comprise:

- (a) The loss of present income obtainable by selling now.
- (b) Storage charges to the date or dates of prospective sale, discounted to the present.
- (c) Losses from deterioration.
- (d) Insurance charges, similarly computed.

The receipts promised are the expected income from sales at later dates, discounted to the present. We may best present the considerations bearing on investments in inventory by grouping storage and insurance charges on account of holding inventory to a given date with the possible receipts from sale on that date. These receipts are then net of these costs. An investor would then compare with the present differential loss from postponement of sales that figure for differential receipts which is highest when discounted back to the time of investment.

The differential receipts from an increment of investment in inventory may be easily computed. An individual firm may take future prices to be independent of its own investments. It will, therefore, compare expected prices, net of carrying charges, and discounted for futurity, with present prices. If any expected figure discounted be higher than the loss from

postponement, an investment in inventory will be considered worthwhile.

The extent of such investments finds a limit, for individual investors, in a diminishing expectation of receipts due to an increase in the discount for uncertainty as the extent of the investment increases. For the group of traders as a whole, investments in inventory are limited as well by a rise in the price of current sales as the size of inventories increases and by decreases in expected future prices.

Investments in stocks of raw materials involve strictly analogous considerations, the attempt being to escape expected higher costs in the future by purchasing now.

A somewhat more complicated set of estimates applies to stocks of partly finished goods. Here the costs of the investment (the receipts from sale now or proximately now) must be reduced by the outpayments for labor and other prime costs involved in the finishing operation, and discounted for the time involved in completion. And this figure must be further reduced by the value of the wear and tear of fixed equipment involved in the finishing operation in a manner to be described in the discussion below of investments in current production.

The anticipated receipts from such investments must likewise be reduced by the anticipated cost of finishing. The cost of finishing applying to sales at *any* future date will be that cost which when discounted has the lowest present value, provided the date is prior to the date of sale contemplated.²

3. INVESTMENTS IN THE PROCESSING OF GOODS

The costs in this case comprise:

(a) Outpayments for labor, power, etc. due to current production.

(b) Outpayments for materials if purchased now or the present value of materials drawn from stock. The latter value

² That is, the firm will contemplate finishing the goods whenever the cost of doing so is likely to be lowest in its own estimation.

is the highest of the future values of this stock estimated as in the section on inventory above. These values (i. e., the present market price of materials and the present value of materials drawn from stock) will be equal only on the margin.

(c) Certain incidental costs ³ which have been recognized in economic literature for some time ⁴ but which have recently become more prominent through J. M. Keynes's discussion of "User Cost." ⁵ These incidental costs are made up of the following items:

(1) Increased wear and tear of machinery. The importance of this item is due to the fact that it brings nearer the date when the machinery or other equipment in question must be replaced.⁶ To bring this negative income item a date nearer to the present is to lower the present value of the capital by the increase in the discounted value of this negative item. This fact is, however, of no consequence if replacement must occur for reasons of obsolescence before it would be profitable to replace on account of wear and tear. And it is of little consequence if an industry's equipment is largely idle, for in this case, the date of replacement is in the relatively distant future and the increase in costs due to bringing nearer the replacement date is then not so great.

(2) Undermaintenance by reason of current production. Maintenance is of two types. One part is necessitated by the mere passage of time. The other is directly due to production. Either or both may be made impossible by reason of the rush of current production. Neglect of maintenance of either type may take its toll in two ways. The first arises if the maintenance is not made up. It takes the shape of higher costs of production either because the per capita output of labor hired is reduced or because the costs of repair and maintenance in the future are

³ It is these costs to which reference was made above, p. 96.

⁴ Cf. J. M. Clark, *Economics of Overhead Costs*, Ch. IX.

⁵ *General Theory of Employment, Interest and Money*, pp. 66-74.

⁶ In general, it brings nearer the periods when costs of production rise due to decreased operating efficiency or higher costs of maintenance and repair.

increased. The second occurs if the maintenance is made up later. In this event we must draw a distinction between the two types of undermaintenance. In so far as the repairs which were skipped would have been necessitated even if production had not been extended, current production must be charged with the discounted value of any difference in the current price of maintenance and its cost when actually incurred. In so far as the repairs are necessitated by current production, this activity must be charged with the entire discounted value of maintenance when this is incurred.

(3) Failure to improve or increase equipment. This may occur at busy times and its cost to the firm is measured by the discounted value of the higher operating costs thus brought into prospect. If the investment is planned for a later date, any difference between its present and future cost must be taken into account.

(4) Adverse effects on the morale of labor. An increased rate of production makes the labor force feel more secure in its employment. As a consequence, observers argue that the productivity of labor falls due to slackness in application to work.⁷

(5) Costs of change in rate of output. J. M. Clark⁸ and others have urged that merely to change the rate of output in either direction involves costs of adjustment of machinery and organization which are substantial.

On any given date, the prices of the factors of production are independent of the rate of output of a firm. This does not, however, indicate that costs of production remain constant as output increases; for with given equipment, the per capita productivity of labor falls as the number of men working increases. This is probably true for most relevant levels of output, although the rate of decrease of productivity may for a time be slight. Moreover as a factory becomes more rushed, it becomes increasingly difficult to keep machinery in repair or to

⁷ Cf. J. M. Clark, *op. cit.*, p. 93.

⁸ *Ibid.*, p. 198.

install needed new equipment. Marginal costs of production are, then, likely to be rising.

The differential receipts from current production are largely a consequence of the increased sales to be expected either immediately upon the completion of the goods, or at a later date. But there must also be taken into account a probable favorable effect on the productivity of labor due to a decrease of conscious restriction of output. And if it is a decrease of the rate of output which is in question, then a decision to maintain output is favored by the avoidance of the cost of restoring the organization of workers later.

The differential receipts from production are, for a firm, the present value of the price at which the goods will sell, the price being discounted for futurity and rendered net of carrying costs if it seems best to produce for inventory rather than immediate sale. Differential receipts will fall even for the individual firm as output increases; for the caution factor which a firm assesses against expected income increases generally as investment grows greater.⁹

4. INVESTMENTS IN EQUIPMENT

In this case, the cost items consist of:

(a) The purchase cost of the equipment and the costs of installing it. The cost must be discounted to the present from the dates of payment.

(b) Incidental losses of opportunities to produce during the time of installation and reorganization of plant.¹⁰

The differential revenue from investing in fixed equipment comprises the present value of the increase in incomes expected in future years either because the cost of operation with new

⁹ See above, p. 84.

¹⁰ For a discussion of some of these opportunities, see J. C. Bonbright, *The Valuation of Property*, Volume I, pp. 71-76. That this item is a substantial one is indicated by numerous examples. The most noted recent example is the cost of installing the new equipment of the Ford Motor Company in 1928 when the plant was idle for over a year.

equipment is lower or because additional equipment yields a greater capacity to produce at any given cost.

By subtracting the differential costs from the differential revenue, the increase in capital from investment on a given date may be secured. There is one further consideration, however, to take into account. Even if an investment appears profitable when viewed by itself, it may not be wise to make it if it makes impossible other, more profitable investments. This is of importance in the case of investments in fixed equipment; for to a considerable extent such investments are alternative to later purchases of the same or similar equipment. If machines are installed at a certain date, the need for additional machines later is less, other things being equal. Yet postponement of the investment may be wise for a number of reasons. It may be possible to purchase equipment later at a lower price. Or perhaps at a later date the plant is expected to be less busy and the installation will involve less derangement of current production. On the other hand, less equipment will be available over the period of delay. Hence current costs of production will be somewhat higher.

The following calculation should determine whether an increment of investment should be made at (say) Date 1 or postponed to Date 2. Estimate the increase in the value of capital from investment at Date 1. Compare this value with the difference between the increase in the value of capital from investment at Date 2 if investment at Date 1 had not been made and the increase in the value of capital from investment at Date 2 if investment at Date 1 is not postponed.¹¹ If the second value is greater than the first, there is some net benefit from postponement; otherwise not.

Differential revenue from investment on a given date probably declines, for firms in competitive industries, as the amount invested increases. The point turns on the effectiveness of new equipment in lowering marginal costs of production. For if this

¹¹ The second value must be discounted to Date 1.

effectiveness did not change, each expansion of investment would increase a firm's capacity to produce by a proportionate amount. And since a firm would calculate that changes in its own production would leave future prices unaffected, the increase in capacity would mean a proportionate increase in receipts. Now it is possible that in respect of some small additions to fixed equipment, capacity to produce at a given cost may increase in even greater proportion. This, in effect, means that firms in the industry secure important economies as the scale of production increases. But it is unlikely that these are often to be found in competitive industries. For if they were to be found, firms would grow so large as to destroy the conditions of pure competition assumed.

The differential costs of adding to productive equipment of a particular sort at a given date undoubtedly rise with increased purchases of equipment. This is not due to the fact that equipment becomes more expensive, for a single firm does not usually strain the facilities of an industry supplying materials. It is due to the fact that as investment in fixed plant increases, this involves a greater and greater derangement of current production.

CHAPTER VI

PRICE-CHANGES AND PLAN-CHANGES

THE object of this chapter is to trace the connection between changes in current and expected prices on the one hand and changes in investments of various types on the other. What we shall investigate are the changes in his plans which a rational business man would make in the light of a change in current prices or of a change in the prices he expects. It is based upon the preceding chapter because it indicates the relation between changes in prices and changes in differential costs and revenues.

The prices that are of interest to us at this point are the following:

- (a) Selling-price of the product, current and expected
- (b) Wage-rates, per unit of product, current and expected
- (c) The price of raw materials, per unit of product, current and expected
- (d) The price of equipment, current and expected
- (e) Interest rates, including:
 - (1) Borrowing rates, current and expected
 - (2) Lending rates, current and expected
 - (3) Rates of time-preference, current and expected.

It may be well to remind the reader that at this point we mean by "expected prices" written without qualification the entrepreneurs' rough mathematical expectation of future prices corrected for uncertainty. For some problems it will be necessary to distinguish the components of the expectations upon which producers act. But for other problems, this is not necessary.

Of the prices listed above, the prices of labor and materials clearly bear the same relation to our problem and they may, therefore, be treated together. Changes in the prices listed above may now be considered in order.

I. THE SELLING-PRICE OF THE PRODUCT.

(a) Suppose that current selling-price rises, but that expectations held of future prices of all sorts remain unchanged. The result of this change must be that stocks are drawn down, for the differential cost of postponing sales of finished goods rises without any change in expected differential revenue from postponing sales. This reduction of inventory, of course, finds a limit. For as the size of current inventories is reduced, the discount for caution applied to the expectation of future prices will fall, and this will gradually raise the marginal revenue from postponing sales.

There is no reason to believe that the planned rates of production or the planned investments in equipment will be changed, for neither the marginal costs nor the marginal revenues from such investments have changed.

(b) Suppose that entrepreneurs' expectations of future selling-prices rise, all other current and expected prices remaining constant, including the current selling price. In this event, we must expect inventories of finished products to be built up for reasons exactly analogous to those which in the first case led us to suppose that stocks would be drawn down; and the same limitations apply.

Whether current production will increase and how much depends on the extent and distribution of the expected price rises. If the price-increases expected in the near future be large and those in the more distant future small, then the marginal revenue from current production will rise relatively far above marginal costs of current production. For the latter will rise only to the extent that it becomes profitable to install machinery which could not be installed while increasing the current rate of output. But if the price-rises in the more distant future are expected to be small, the rise in marginal-costs on this account will probably be small. To increase current production and sale is, therefore, profitable.

On the other hand, if increases in price in the near future are expected to be relatively small and those in the more distant future relatively large, these expectations will not justify more than a relatively small rise in current production and there may even be a decrease in current production. The reason is that the marginal cost of producing currently must rise substantially.¹ This is likely to occur because, given the expectations postulated, producers will consider it very profitable to install machinery. And they will count it a cost to give up the opportunity to do so quickly in order to extend current production. Moreover, of the current work put into production a greater proportion will be not for sale as soon as completed, but for sale at a later date. But if current production does not rise, then current selling price must rise as a consequence; for inventories are being increased. And thus price-rise will act to check the increase in inventories.

The extent of current investment in equipment likewise turns on the extent and distribution of the price-rises expected. The greater the price-rises involved, the greater the incentive to invest in equipment. But if the distribution be uneven, it may be that the increase in current investment will be very small or there may be no incentive to increase the rate of investment in fixed equipment beyond the rate originally planned. Thus if prices in the relatively near future are expected to rise a great deal, while prices in the relatively distant future are expected to rise to a lesser degree, the marginal cost of investment will be very great in the near future, to the extent that such investment deranges current production.

(c) If both current prices and the expectations of future prices rise, only investments in inventory are different from what they are in (b) above. But the discussion of sections (a) and (b) are sufficient to point to the solutions.

¹ Of course, the elasticity of current supply will be low relative to that of future supply because the latter will have the benefit of greater equipment. But this is here neglected.

These cases can easily be extended by the reader to deal with price-falls.

2. WAGE-RATES AND THE PRICE OF MATERIALS. (FACTOR PRICES).

We shall refer to the two prices considered together in this section as "factor prices."

(a) Suppose, first, that there is an increase in current factor prices unaccompanied by any rise in the expectations of entrepreneurs regarding future prices, and that all other things remain constant. In this case, the expectations of the entrepreneurs give them no incentive to change their investments in their inventory of finished goods. For the costs and revenues attached to such investments are affected only by present and future selling-prices of the product. There is, however, an incentive to add to one's stock of partly finished goods; for the expense of finishing goods now has risen as compared with the expense of finishing them later.² If, as seems likely, an increase in current factor prices gives rise to an expectation of higher selling prices in the future, there is a justification for an increase in inventories of both sorts.

Current production should fall due to the rise in the marginal cost of such production. The rate of production planned for future periods will be reduced, however, only to the extent that current production is complementary to future production, for otherwise there is no expectation that either the differential costs or revenues from future production will change. One example of current production which is complementary to future production is the current addition being made to the stock of partly finished goods. So far as this is concerned, a larger future production will be planned, at least for a time. Another example is current investment in the installation and maintenance of equipment. So far as this is reduced because of higher current costs of labor and materials, this will raise the

² See above, p. 96.

marginal cost of production in the future and, *pro tanto*, a lower future output should be planned.

(b) Suppose that factor prices are expected to rise in the future, current factor prices and all other prices, current and expected, being unchanged.

Again, there is no incentive to alter one's investments in inventory of finished products.³ But since the marginal costs of production in the future are expected to rise, a smaller future output will be planned. In producing this smaller future output, moreover, a larger proportion of the work will be done currently. This implies a larger investment in inventory of unfinished goods and, therefore, current production to build it up, and a larger current investment in equipment than was originally planned.

(c) A general rise of factor prices, current and expected, other things being equal will result in plans for smaller output generally. But in the production of this smaller output, a larger part will be played by equipment, and this may, therefore, involve an increase in the plan for current investment in machinery and plant.

If the rise in the prices of factors is expected to be equal in every future period, the decrease in production may not be the same throughout; for it is likely that the elasticity of supply will be greater in the more distant future.

3. THE PRICE OF EQUIPMENT.

(a) Suppose there is an increase in the current price of equipment, expected future prices and all other factors remaining constant. Then the current rate of investment in equipment should decrease, for the differential cost of such investment has increased. This is so for two reasons: the price of the equipment has risen and there is more likely to be found a positive advantage in delaying investment. Since a decrease in fixed

³ Except in so far as the expectation of higher costs in the future carries with it an anticipation of higher selling prices.

equipment leads to an increase in the differential cost of production later, the results of 2 (b), above⁴ should follow with the exception that the increased investment in equipment there envisaged would be checked by the higher current cost of such investments.

(b) Suppose there is an increase in prices of equipment expected in the future. In this case, the total installations of equipment planned for the future will fall, since the marginal cost of the equipment is expected to rise. Of this lower total, a certain part would probably be produced and installed currently. For if on the previous set-up of costs a certain program of installations was adopted, it seems likely that this program would be shifted forward somewhat in order to escape the higher prices expected—there is less likely to be advantage in delay. This advancement of the program however has its limits. If equipment is installed before it is needed, the marginal revenue from such an investment is reduced.

If there is, in fact, an increase in current investment in equipment, this raises marginal costs of production currently to the extent that such installation work interferes with current processing of goods. The marginal costs of production are also raised currently to the extent that current production causes the depreciation of equipment, for with higher prices for equipment expected the rate of depreciation must be raised. The implications of such an increase are set out in 2 (a), above.

If, however, the advancement in time of the program of investment in equipment results, for a time, in a stock of equipment available for use larger than was originally expected, then for this period marginal costs of production will be lower than was expected and a larger output of goods in this period is called for.

After a time, however, the stock of equipment available for use will be smaller than was expected, and marginal costs of production will be higher than was originally expected, because

⁴ See p. 106, above.

of the smaller supply of equipment and also because the rate of depreciation is higher. The expectation of such an outcome has implications set out in 2 (b), above.

(c) Suppose, finally, that current prices for equipment rise and that there is also an expectation that future prices will rise. This amounts to a rise in the marginal costs of investment in such equipment. If the increases in prices expected are of the same magnitude at all dates, then total investments in such equipment become less profitable and there is not likely to be any significant shift in the proportions planned for installation in various periods.

Marginal costs of investment in the processing of goods, however, are not thereby raised generally. For the present, indeed, they may well be lowered. For in the present, there is no decrease in the supply of equipment expected to be available. Moreover, since the rate of investment in fixed plant is being reduced, there is less interference from this source with current processing of goods. On the other hand, since the price of equipment is expected to rise, the expenses on account of depreciation must increase.

In the future, however, the marginal costs of production must rise for two reasons: the supply of equipment available will not be so large as it was originally expected to be and the expenses on account of depreciation are higher per unit of product. Hence the costs of production in the future relative to costs in the present are almost certain to be greater than they were expected to be. The implications of this change for plans for investments in inventory and output, current and future, can be deduced from the considerations raised in Sections 1 and 2 of this chapter.⁵

⁵ Nothing need be said at this point concerning the effect of changes in the design of machinery, inventions, and so on, for an improvement in the design of machinery can be thought of as a decrease in the cost of equipment. Then the analysis of this section has already dealt with the problem.

4. CHANGES IN INTEREST-RATES.

The difficulty in tracing the relation between interest rates and production plans lies largely in finding the connection between changes in interest rates and changes in the discount factor which business men see fit to apply in valuing future revenues and outlays. This connection was, however, treated at length in a previous chapter.⁶ Our problem here is the simpler one of stating the effect upon production plans of given changes in the discount factor applied.

The form of our analysis must be somewhat different in this case, since all discount rates apply to revenues and outlays which are future to some extent.

(a) Suppose a general rise of discount rates applying to all periods alike. In this event, there must clearly be decreased investment in inventory since the marginal revenue from postponement of sales is reduced.

Investment in current production will fall, but only to the extent that payment for sales lags behind outlays involved in production. Investment in equipment must also fall, since the effect of an increase in the discount factor is to lower the marginal cost of investment, largely incurred in the near future, by less than the marginal revenues from investment, largely realized in the more distant future. And this tendency to decrease investment in equipment will act more strongly on invest-

⁶ In general, it will be seen from the discussion of Chapter IV that a change in interest rates whether current or expected will cause the discount factors appropriately applied to change in the same direction. For while the marginal rate of time-preference for some firms may lie between the minimum level set by the expected receipts from lending and the maximum level set by the expected costs of borrowing, many other firms whose rates of time-preference lie either at the lower or upper limits of the range will find the rate of discount appropriate for them changed.

If marginal rates of time-preference, current or expected, change, this will alter the appropriate rates of discount in the same direction, directly for some firms and indirectly for others through the effect of a change in rates of time-preference upon interest-rates. On the latter point, *cf.* Fisher, *op. cit.*

ments whose returns come relatively late than on those whose returns come relatively early.⁷

(b) Suppose a rise of discount rates, but one in which rates for the relatively near future rise more sharply than those for the more distant future.

Here again investments in inventories must fall more sharply, if it is planned to hold the stock for a short while; less sharply, if it is planned to hold it for a long while.

Investments in current production will be reduced as above; but the discouragement of investment in equipment will not be so great as it was found to be above. Marginal revenue from investment will fall; but the discount factor applied to marginal costs will be even greater; and it is conceivable that investment in equipment will even be stimulated.

The discussion of this chapter has served to indicate in what complex and indirect fashion the marginal revenue and marginal cost of investments of different kinds are affected by price-changes, but it has dealt with the problem from the point of view of an individual firm. The next chapter will cover the ground from the point of view of the whole of a competitive industry and indicate how the differential costs and revenues from investment of different types over a period may be derived from given movements in the conditions of demand for the product and of the conditions of supply of the factors of production.

⁷ In so far as current investment in equipment is reduced, this has the effect of reducing temporarily the marginal costs of processing goods. For again, the supply of equipment is for a while substantially as great as it was expected to be, while interferences with production operations are reduced. At the same time, the increase in discount rates reduces the present value of the expected expenses for replacement involved in current production.

CHAPTER VII

A PLAN OF INVESTMENT FOR AN INDUSTRY

It will be useful at this point to see how far the essay has come. The object of the analysis is to secure a method of predicting business men's investments in a changing economy and of describing the consequences significantly. By a changing economy has been meant one in which the conditions of demand for a product and of the supplies of the factors of production are changing in some way or other. More precisely, we mean that the demand curve for an industry's output and the supply curves of the factors of production used by an industry are shifting, that the technique of production is changing and that interest rates do not remain constant.

To this point, there have been described the various factors which, given anticipations of future conditions, determine business decisions about investments. The analysis has applied to a single small firm in a competitive industry. The determining factors have been gathered together by considering them in terms of a business man's estimates of the way these factors affect the differential cost and the differential revenue from investment. That is, we have asked how much a man thinks a given decision subtracts from and how much he thinks it adds to the value of his "capital." Since his objective is to maximize the value of his capital, a business man tries, at every moment, to dispose his investments in such a way that the differential cost and differential revenue from investments of every kind are equal.

Now, if one knew what business men thought were the differential revenues and costs of investments of different amounts at various dates over a period of time, one could also predict the movements of the rate and character of investment over the period. These estimates of revenues and costs, how-

ever, depend upon the anticipations of business men; and these anticipations in turn depend upon the experience of business men before and during the period under review. An attempt to derive these anticipations and thus the investments of business men will be made in the chapter following this.

In order to describe the investment decisions of business men in a significant fashion, however, some standard of comparison is necessary. That is, some standard pattern of investment must be defined in terms of which the actual pattern will take on meaning. How the standard pattern may be derived is the subject matter of the present chapter.

I. A STANDARD PATTERN FOR INVESTMENTS.

The standard for investments here proposed is that pattern of investments which would cause the appropriately discounted differential costs and differential revenues from investments at every date over a period to be equal. This is the same as saying that the standard is that set of investments whose results bear out the expectations of the entrepreneurs.

There is a superficial appearance of identity between this standard and that of stationary state equilibrium. The content of the terms "differential cost" and "differential revenue" is, however, radically different in the use to which the standard here proposed will be put. The differential costs and revenues of which the present analysis treats are estimated from the elements of a changing not a stationary situation with respect to cost and demand. For example, an investment which is correct in view of an unchanging technical situation is not calculated to maximize the capital value of a firm in an economy marked by technical advance. The point need not be labored.

There is a second sort of difference in the two concepts. Stationary state equilibrium was generally defined by a set of conditions with respect to supply and demand which were assumed to be independent of the investments made in view of

these conditions.¹ This was a fault even within the framework of the older theory. It would be a fatal limitation to the method of analysis here proposed. It is intended to pursue the analysis in a fashion which is not subject to this limitation.

Now in order to secure the standard pattern sought, it is necessary to derive from a given set of changes in the demand curve for output, in the supply curves of the factors, in the technique of production, and in the interest rates to the firms in the industry, curves relating differential costs and revenues and investments of different kinds for the period studied. The investments must be those of the entire industry (not of a single firm as hitherto). If this were possible, the "correct" pattern of investment could be secured by reading off the quantities of investment indicated by the points where the curves crossed.

The chief difficulty in the way of deriving a correct pattern of investment from given conditions of demand and of the supplies of the factors is that the actual investments made at any point affects the investments which are correct thereafter. This is so first because investments at a given point in time can affect the demand for the product or the supplies of the factors at later times. To give just one example at this point: suppose such a rate of investment in the processing of goods at a certain time that the price of the product falls. If this gives rise as it may to anticipations among purchasers of a continued drop in price, the demand for the product for some time will be less than it otherwise would be. The same sort of difficulty appears, secondly, because one has to specify the amount of equipment and of raw materials and finished goods on hand at any time in order to estimate the revenues and costs of additional production. These difficulties must be taken into account, and it is proposed to do so in a step-by-step fashion.

¹ This is not to say that stationary state theory does not take account of the fact that (say) the short-period supply curve is affected by investments based on the long-period curve. But it does not take account of changes in the long-period curve itself which are caused by such investments.

The first step in the analysis will, therefore, be made on the assumption that the demand curve for the product and the supply curves of the factors are not affected by the investments made. Having shown how to derive a pattern for investments on this assumption, we shall go on to consider briefly how investments of different types alter demand and cost conditions.

The problem of modifying the standard pattern for the future in the light of investments made at every point will then be handled in Chapter VIII, when we shall have before us the actual pattern of investments which characterizes the particular period there studied, namely, a business cycle.

2. DIFFERENTIAL COST AND DIFFERENTIAL REVENUE CURVES FOR AN INDUSTRY WHEN DEMAND AND COST CONDITIONS ARE INDEPENDENT OF INVESTMENTS.

In Chapters III-V, we saw how a firm laid out for itself an investment plan on the basis of its estimates of the selling-price of its product and of the prices of the factors used in production at various dates in the future. Since the firm was a small element in the market, it could take these prices to be independent of its own actions. On the basis of these data, it estimated the differential revenue and differential cost of investments of various kinds at various dates in the future and planned to invest such an amount as would render these variables equal. Subject to an important qualification,² this plan would be the "standard" plan for the firm if its anticipations of future prices and other cost conditions were correct.

Our problem here, however, is to derive a correct plan of investment for an industry as a whole, a plan of interest to an external observer as a standard by which to measure the actual performance of the industry. Our discussion at this point therefore faces an additional complication. When the problem is one

² The qualification in question refers to the fact that a firm discounts its estimates for caution. For various reasons, a student deriving a standard plan of investment from given conditions cannot take this into account. The consequences of this fact are discussed below, pp. 132-134.

of the action of whole industries, prices depend upon the investments made by the industry; hence the differential revenue which emerges also depends on the investments made by the entire industry. The data are the demand curves for the product and the supply curves of the factors. Selling prices depend upon the demand curves and upon the total sales planned for each date. Factor prices depend upon the supply curves and the total purchases planned for each date.

The significance of these facts for calculations of the differential revenue and costs of investment must be clearly understood. The revenues and cost curves which, for the external observer, apply to whole industries are not to be derived from prices expected by the entrepreneurs who are making plans, but from an assumed set of cost and demand curves in which price varies with the quantity sold or bought. For example, for an industry, differential costs tend to rise³ as the rate of production is increased, not only because factories become more crowded, but also because additional quantities of the factors of production cannot always be secured at the same price as smaller quantities. And similarly the differential revenue from investment in fixed equipment tends to fall as investment increases, not only because the effectiveness of additional equipment in lowering prime costs becomes smaller, but also because the additional output will sell for a lower price. In every case in which materials are to be bought or sold in the future, an approximate discount factor must be applied. No allowance should be made of course, for the fact that the additional production lowers the prices at which previously planned production will sell. The reason is that we are dealing with a competitive industry, in which each producer must take the industry's production and, therefore, price for granted. The revenue to the industry from additional production should, therefore, be calculated in disregard of the fact that additional sales lower the price of all sales. To take account of this fact

³ In most cases.

would make the standard pattern of investment for a competitive industry the same as that for a monopolized industry.

3. DIFFERENTIAL REVENUES AND COSTS FROM INVESTMENTS IN THE PROCESSING OF GOODS.

The calculation of the differential costs of investment of any particular type is further complicated by the fact that the costs of investment of any one type depend in part upon contemporaneous opportunities to invest in other ways. For example, we saw in Chapters V and VI⁴ that if additional installations of fixed equipment deranged the processing of goods, this had to be counted as a cost of investment in fixed plant. These costs can only be taken into account adequately after the analysis of all three types of investments, for only then can the relative profitability of additional investments of different types be compared. The present writer prefers to begin with investments in the processing of goods.

We take the following as given: (1) the demand curve for the product of the industry, the supply curves of the agents of production to the industry and the technical conditions of manufacture. Moreover, all of these factors are taken to be in movement in specified fashions; (2) the quantity and quality of equipment available at every date during the period studied and the net losses due to interference with investment of other types on account of increases in production. These assumptions define the prices at which sales of various amounts can be made at every date and the expenses involved in increasing production at each date. We also take as given (3) the movements in interest rates from which the movement of discount rates may be derived. This gives the possibility of reducing future prices and costs to values of the time of calculation.

We assume also (4) that there is a fixed production period for the processing of goods so that if goods are to be sold on a certain date they must have been put into production at least

⁴ See above, pp. 99-101.

a specified number of days earlier. And, provisionally, we assume (5) that no production for inventory is possible, so that goods must be sold as soon as they are finished.

The last two assumptions make it very easy to say what are the differential revenue and cost curves applying to production on any given date. An observer's differential revenue curve applying to investments in processing made on any given date is the same as the demand curve for the product applying to the date on which the goods will be ready for sale, each price being discounted back to the date on which plans are made. The differential cost curve represents the discounted expenses of producing additional goods for the particular selling date in question.

The differential revenue curve for a given date is a negatively sloping curve because additional quantities will be absorbed by the market on a given date only at a lower price. The differential cost curve is an upward sloping curve at least beyond a point for several reasons: (1) as additional work is put in process, plant and equipment are crowded and overtime or night rates paid; (2) interferences with opportunities to install and maintain plant increase; and (3) the prices of labor and materials are pushed up.

The correct rate of output and of investment on any date are those for which the discounted differential cost equals the discounted differential revenue. And in this case, the discounted differential revenue equals the price, discounted. Like calculations for other dates would yield a complete production plan for the industry over the period.

The problem becomes more difficult of solution when the possibility of producing for inventory arises. If the plan, as derived above, indicates that a price on any one date will be higher than the price on some earlier date after allowing for the firms' discount of future prices and the costs of storage,⁵ it

⁵ See above, p. 95. The price may be higher on the later date because either the costs of production or the demand is greater for the later date than for the earlier.

will be worth while to put some of the product of the earlier date into inventory for sale on the later date.

The observer in reworking his standard production plan, must then keep two considerations in mind. One is that if goods are put into inventory at a certain date and sold at a later date, this raises the price which will rule at the earlier date and lowers that for the later date. This means that the amount which it is worth while to produce (for sale and inventory together) at the earlier date is greater than it otherwise would be. Similarly, it means that the amount which it is worth while to produce for the later date is less than it otherwise would be. The second consideration is that the production-and-sales plan must be finally so altered that the price secured on the later date is not higher than the price at the earlier date by more than the carrying costs and the discount factor.

A graphic solution of this problem for two successive dates is given below:

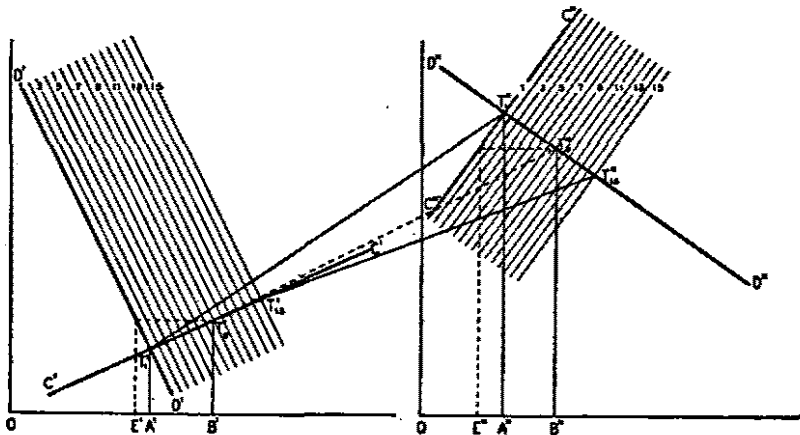


Figure 5

$D'D'$ and $D''D''$ are the demand curves for the two dates, all prices discounted to the date of planning. $C'C'$ and $C''C''$ are the marginal cost curves applying to production for the same dates, and similarly discounted. The production which would be

planned for the two dates, if there were no question of production for inventory is OA' and OA'' , respectively. T_1' and T_1'' are the corresponding prices. By hypothesis the second is greater than the first by more than the discount rate and other costs of carriage. Some production of the earlier date should be carried over to the latter.

Now if, of any stated quantity, a certain amount is removed from the market, the total production may be increased by the same amount without breaking the price. To represent this, draw lines parallel to $D'D'$ at equal small horizontal distances to the right. They represent the different rates of production for the early date which are consistent with various prices, because successively larger amounts are held in inventory. (Speaking loosely, we may say that as the amount carried over increases, the "demand curve" shifts to the right.)

Similarly at the later date draw curves parallel to the marginal cost curve $C''C''$ to indicate that the quantities which can be brought to sale at the later date at given marginal expenses of production become greater and greater as greater and greater quantities can be secured from inventory. (Speaking loosely, again, we may say that as the quantity available in inventory increases the marginal costs curve shifts to the right.)

To discover what amounts should be produced for and sold on the two dates, the following procedure may be used. The lines drawn parallel to $D'D'$ cut the marginal cost curve for the earlier date at successively higher prices. The lines drawn parallel to $C''C''$ cut the demand curve for the later date at successively lower prices. Now by successive approximations a pair of corresponding curves can be found (in this case D_0' and C_0'') which mark off prices (T_0' and T_0'') such that the second is higher than the first by just the discount between the two dates plus carrying-costs.⁶ These intersections indicate: (1) that the amount OB' should be produced at the earlier date and

⁶ If one tried the curves marked "15", the difference in price would be too small, just as the difference between T_1' and T_1'' is too great.

that $E'B'$ should be held in inventory. The price then is T_0' as indicated; (2) that OB'' should be sold on the later date at price T_0'' . Of this amount, OB'' , only OE'' should be currently produced, for the marginal cost of $OE'' = T_0''$. The rest $E''B''$ comes from inventory. It is an amount equal to the carryover $E'B'$; for C_0'' is the same distance to the right of C_1'' as D_0' is to the right of D_1' .

By this same method, and in a step-by-step fashion readjustments of the standard production-and-sales plan may be made for all dates. The conditions which must characterize a plan which is finally correct are: (1) that inventory be finally sold out, (2) that as between any two dates between which stock is carried, the difference in expected prices be just sufficient to offset the discount rate and carrying costs, (3) that for every date the output be such that the differential costs of production and differential revenue (price) be equal, when both are appropriately discounted.

In this way, under the conditions imposed, a plan of production and sales to serve as a standard for the future investments of an industry with given quantities of equipment may be discovered. It is characterized by the fact that for every date the differential costs of investment in production equals the differential revenue. Whether the standard pattern of investments is actually followed by an industry over a certain period depends upon the anticipations of the members of the industry. If every firm expects the very prices (both selling-prices and factor-prices) to rule which would in fact result if the standard pattern were followed, and if each correctly estimates from these data his marginal costs of production, according to the considerations raised in Chapter V, the industry's investments and output will in fact, follow the standard pattern.

If selling-prices⁷ other than those which would result from the standard plan of investment are expected, then a plan other than the standard plan will be adopted. How it would differ

⁷ Or factor prices, or factory efficiency.

from the standard plan can be found from the argument of Chapter VI, where the effect of expected price changes upon business plans is considered. If (say) larger than standard investments are made when the plan is first put into operation, the marginal costs of investment will later be found to have been greater than the marginal revenues from investment. The members of the industry will realize this as soon as they experience selling-prices other than those expected. This will lead to a revision of their plans; but now it will be possible for an observer to compare their revised plan with the original standard only if their first investments have not affected the future conditions of demand and cost. How investments do affect these conditions will be discussed later in the chapter. We must first consider how to derive a standard plan for the disposition of an original stock of goods and for investments in fixed plant under the same conditions as ruled the discussion of investments in the processing of materials.

4. DIFFERENTIAL REVENUES AND COSTS IN THE DISPOSITION OF AN ORIGINAL STOCK.

In our discussion earlier in the chapter, it was assumed that the industry held no stocks of finished goods at the time plans were first made. It is necessary to see what difference this possibility makes. But after the earlier discussion, the problem is easily handled.

When the production plan is finally settled according to the method of section 3 of this chapter, it is possible to compare current prices with those which the standard plan would produce. If none of the future prices are higher than current prices by more than an amount necessary to offset the discount and the carrying costs, the stock on hand should be sold for what it will bring immediately. Very often, however, it will be profitable to hold part of the stock for future sale. In this event, the problem of adjusting production plans to the price changes caused by the disposition of inventory arises. The problem can be handled on the same lines as were followed in section 3.

A graphical solution of the disposition of stock on hand between immediate sale and a given future date follows:

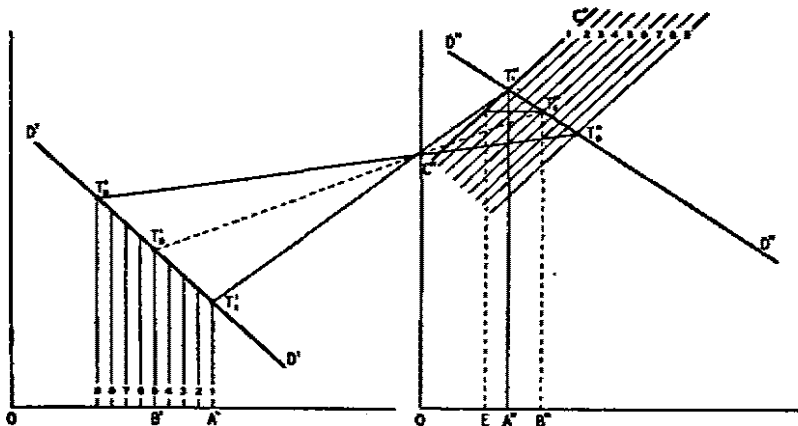


Figure 6

$D'D'$ is the demand curve applying to the time of planning. $D''D''$ is the demand curve applying to the date at which it is proposed to dispose of the goods held over from the earlier date. $C''C''$ represents the marginal cost of processing goods for the second date.

The prices which would rule if no goods were carried over are $A'T_1'$ and $A''T_1''$. The difference between them indicates the advisability of some carryover. Now draw lines parallel to $A'T_1'$ to indicate the effect upon current price of successively larger amounts taken off the market. And as in figure 5, above, draw lines parallel to $C''C''$ to indicate the effect of the carryover upon the supply situation at this date. Again by successive approximations a pair of lines will be found which intersect prices, the difference between which will just offset the carrying costs and discount. If an amount equal to the difference between A_1' and A_5' is held over and sold later the difference in price almost disappears. But an amount equal to the difference between A_1' and A_5' may be just right. Then the prices become T_5' and T_5'' . OB' is sold at the first date; $B'A'$ is held over. OB''

is sold on the later date. This quantity is made up of EB'' ($= B'A'$), the amount carried over plus OE , the quantity especially produced for this date.

This adjustment may make other readjustments of plan necessary, but they can all be handled in the same fashion.

5. DIFFERENTIAL COSTS AND REVENUES FROM INVESTMENT IN FIXED PLANT.

We take as given, as in the problems above, a demand curve for the product and supply curves of the agents of production which shift over the period in some specific fashion. We also assume that whatever equipment is available on any given date will be used to best advantage.⁸ The second assumption is necessary if anything definite is to be said about the future income connected with an increment of investment in fixed plant. This is, doubtless, arbitrary. But some assumption must be made, and it seems probable that the profitability of investments in fixed plant turns much more on the quantity of such investment than upon the wisdom with which it is used.

Given these conditions, a plan for plant investments may be formulated. A schedule of additional revenues from increments of investment on the first date for which the plan is to apply can be drawn up in the following way. Consider the effect of a small addition to equipment. This will cause marginal costs of processing goods to shift downward in some specific way, in general making it possible to produce a larger quantity of goods for any given marginal cost. This, in turn, means that a larger output will be planned (according to the method of section 3 of this chapter) over the life of the investment. Now multiply the additional output planned at every date by the price for which these outputs will sell. Discount to the time of planning and add the results. Compute also the prime costs of producing the additional output. Discount these to the time of planning and add them together. Subtract the sum of the discounted costs of

⁸ In the conditions of competition assumed.

future additional production from the sum of their discounted values. The result is the additional revenue from the increment of investment. By repeating this operation for repeated increments, the schedule desired is secured.

The differential revenue from such investments is likely to fall as the amount of investment increases. In the first place, it is probable that at least after a certain point,⁹ the effectiveness of additional equipment in lowering the marginal costs of production is likely to fall,¹⁰ within any given firm. To the extent that new firms are organized, it is likely that the organizers must be drawn from increasingly profitable alternative spheres of business. This fact means that the additional revenues when considered *net* of these alternative profits are falling. And finally the prices at which additional output will sell will fall as investment and, therefore, output increases.

A schedule of differential costs attached to increments of investment on the same date may also be secured. The cost of an increment of equipment may be found from the supply curve of that type of equipment for the date in question. The cost of this equipment will, in general, rise as additional quantities are bought by the firms of an industry. The marginal costs, in so far, are, of course, equal merely to the increment times the price for which it is bought. At the same time, as the quantity of equipment being installed on a given date increases, it seems likely that, in most cases, the incidental costs of installation become greater.¹¹ the cost which arises from interferences with current production during installation—probably the most important of the incidental expenses—can be found from the

⁹ This point is likely to be quickly reached in competitive industries.

¹⁰ This is due finally to an increasing disproportion in the combination of factors used as the scale of production increases. The factor which in the nature of the case cannot keep pace with the others is that which furnishes organization and ultimate decision to the firm. For an extended argument on this point, see Kaldor, N., "The Equilibrium of the Firm," *Economic Journal*, March, 1934, pp. 60-76.

¹¹ See above, p. 99.

calculations which underlie the production plan. It is equal to the reduction in current output times the price for which this output would sell.

The point at which the rising differential costs curve, figured as above, meets the falling differential revenue curve indicates the amount of investment which is standard for the date in question—provided there are no positive advantages from delaying investment to a later date. These ought to be calculated for every increment of investment considered, according to the method set out in Chapter V,¹² for as soon as positive advantages to delay appear, this, in effect, makes the marginal costs of investment greater than the marginal revenue. This is so because the method of calculation is really a complete comparison of the increment to capital value to be secured by making a given investment on a certain date as compared with postponing it to a certain later date. It may here be pointed out that in comparing investment on any given date with any later date the advantages of delay are greater (a) the more cheaply the equipment can be purchased in the future as compared with the present, (b) the less are the incidental costs in the future as compared with the present, (c) the smaller are the additional net revenues foregone by delaying the investment, and (d) the greater the additional net revenue thus secured because equipment which is installed later will be useful to a more distant date in the future. From this it can be seen that as investment proceeds on any given date, the advantages of delay become more and more likely to overbalance the disadvantages. For equipment and incidental costs are becoming greater, the net revenues foregone by delay are becoming smaller, and the net revenues to be secured by delay remain unaffected, until the point is reached when an increment of investment ought actually be postponed.

From these calculations, the "correct" amount of investment for a given date may be found. One can then proceed to the

¹² See above, p. 100.

next relevant date and repeat the procedure and thus, step-by-step, secure a complete plan of investment which will be standard for the industry for the period, for on every date, the differential revenues from investment will be equal to the differential costs.

6. THE DEPENDENCE OF CONDITIONS OF DEMAND AND COST UPON THE INVESTMENTS OF AN INDUSTRY.

The argument of this chapter has proceeded thus far upon the assumption that the demand for the commodity studied and the conditions of supply of factors to its producers, while themselves changing in some specific fashion, were not influenced by the investments of the industry in question. Upon this assumption, "standard" plans for investments of various sorts were derived from the assumed changes in the conditions of demand and of the supply of factors. In reality, however, an industry's investments do influence the conditions of demand and cost. This fact must now be taken into account.

It means, first of all, that our general plan for analyzing the adjustments of an industry to a set of changing conditions must follow a more complicated series of steps than would otherwise be necessary. If the problem of dependence now raised did not exist, the steps in the study of a changing period would be: (1) derivation of a standard plan from given conditions of change, (2) derivation of an industry's actual investments from business anticipations at the various dates covering the period, (3) comparison of actual with standard investments. In view of the dependence which exists the steps of the analysis must be: (1) Derivation of a standard plan of investment from the given conditions of change, upon some meaningful assumption as to the investments of the industry at each date. The assumption which will be made is that the "correct" rate of investment for the industry is actually adopted at every date. (2) Derivation of actual investments at the very beginning of the period from the anticipations which rule at that time. (3) Comparison of actual with standard investments for the dates in question. (4)

Revision of the standard plan, for the remainder of the period, in view of the actual investments already made, assuming that "correct" investments are made in the future. (5) Derivation of actual investments made at the second stage from anticipations at this state. (6) Comparison of actual investments with the standard plan for this stage; and so on, step-by-step.

Now two steps are missing in our study for the prosecution of this more complicated program. The first is a discussion of the influence of investments upon future conditions of demand and cost. The second is some method for determining business anticipations under different conditions. The first of these steps will be taken immediately. The second will be taken in Chapter VIII, in connection with an experiment in the application of the method outlined above.

The discussion of the connection between investments and the conditions of demand and cost will proceed on the following plan. We shall first attempt to list the factors upon which the conditions of demand and of the supplies of factor depend. When this has been done, it will be possible to see which of the determinants of demand and costs are independent of, and which are dependent upon, the investments actually made by an industry, and what the nature of the dependence may be.

7. THE DETERMINANTS OF CONDITIONS OF DEMAND.

It is perhaps best to commence with two warnings. One is that we are concerned here with the determinants of the actual demand for a commodity and with the actual costs of producing it; we are not here concerned with the determinants of what producers think these categories are. The latter question will be considered in the next chapter. And, secondly, we are concerned here with the conditions of supply and cost as they apply to an industry as a whole and not to a single firm within the group.

The following factors pretend to be an exhaustive list of the immediate determinants of the demand conditions facing an industry:

(1) The income of consumers. If the demand for a product be furnished by an industry for which the product is a raw material, then it is the demand for the product of the customer industry which is the analogous factor.

(2) The relative preference of consumers for the given commodity as compared with other commodities. If the commodity be used in further production, the relevant factor is the technical efficiency of the commodity in the process in which it is used, as compared with competing commodities.

(3) The prices of "competing" commodities, current and expected.

(4) The prices of "complementary" commodities, current and expected.

(5) The stock of unutilized services of the commodity in question in the hands of consumers.

(6) The prices charged for the commodity in question in the past and currently.

(7) Consumers' anticipations of future prices.

Of these seven factors, it is clear that numbers 1 and 2 are completely independent of the investments of the industry.¹³

Factors 3 and 4 are clearly dependent in part on the actions of the industry. The demand for the product of industry A depends on the price at which competing commodity B can be secured and on the price at which complementary commodity C can be secured. But if the supply of A at any price increases so that its price falls, the demand for B will decrease, its price will fall, and the demand for A will be reduced in consequence. In similar circumstances, the demand for complementary commodity C will increase, its price will rise, and the demand for A will thus again be reduced. It seems justifiable, however, in an elementary treatment of the subject, such as this pretends to be, to treat these reactions upon the demand conditions for an industry as of secondary importance and to neglect them. They

¹³ For No. (1) it is necessary to assume that the industry is not a large factor in the disbursement of earnings to the community.

will actually be of no importance where the industry studied is small relative to industries producing competing or complementary commodities. In still other cases the effect of these interactions will be negligible by comparison with the other factors involved.

There remain factors 5, 6, and 7, which are clearly dependent in substantial part upon the investments of the industry in question and which, in turn are of substantial consequence for the demand for the product of the industry. It is not difficult to see their influence. For example, large supply and low price, often a result of the action of the industry itself, will encourage consumers to build up their inventories of the commodity. In subsequent periods, the amounts they will take at various prices will be smaller than they otherwise would have been, other things being equal.

Factor 6, the prices, past and present, charged for a commodity are, of course, determined in large part by the past investments made by an industry. The influence of these prices upon future demand arises from their influence upon the habits of purchasers and upon their plans for future consumption. Large output and low prices in the past mean that consumers become more habituated to the use of the commodity than otherwise. They will be willing to offer higher prices for given quantities of the commodity in the future. This is reinforced by the fact that industrial purchasers under the influence of the past make plans and commitments for the future which entail a larger use of the commodity than they would have contemplated, had their experience with its use been more limited.

Finally the amount of demand at various prices is determined by the anticipations of future prices to which a current price-change gives rise. But since the prices against which the last established price is compared were themselves fixed in good part by the past investments of the industry, these must bear a share of the responsibility for the determination of current anticipations. A sudden and isolated rise in price is likely to reduce demand; consumers anticipate a return to a more usual

level of price. A price-rise superimposed on a rising price-trend is likely to cause an increase of demand; consumers fear a continuation of the rising trend and wish to protect themselves from it.

The relation between these factors, 5, 6, and 7, and the marginal revenue from investment is different for different types of investment. They are clearly of negligible importance for investment in durable plant and equipment. The installation of equipment will not change the amount of the product which people will buy at various prices. The operation of that equipment, that is, firms' investments in current production will, no doubt, do so. But this will hardly affect seriously the revenue from the investment in equipment. For while current production may cause oscillations in the conditions of demand, there seems to be no reason to suppose it will have any cumulative effects. Current production may then somewhat alter the time distribution of revenue; but even so this can hardly have a serious effect on capital values unless there were some large and systematic shift; but this is hardly plausible.

On the other hand, these factors are just as clearly important for investments in inventory and current production, for such investments depend for their profitability largely on positions held by demand conditions for only a short time.

8. THE DETERMINANTS OF THE CONDITIONS OF COST.

The following is offered as a complete list of the immediate determinants of cost conditions.

(1) The state of the arts; technical knowledge as it applies to the industry studied.

(2) Movements in the supply conditions underlying the production of raw materials and equipment.

(a) Technical conditions of production of raw materials and equipment.

(b) Factor prices in industries producing raw materials and equipment.

- (c) Alternative demands for raw materials and equipment.
- (3) Past and current prices paid for materials and equipment
- (4) Supply conditions of labor.
 - (a) Relative preference of workers for various industries.
 - (b) Income of wage-earners.
 - (c) Alternative demands for labor.
 - (d) The productivity of the workers.
 - (e) Current and past levels of wages and employment.
- (5) Suppliers' anticipations of the future.
- (6) The stock of raw materials, parts and machinery and equipment currently held by the industry studied.

Of these six factors, the first two are largely independent of the actions of the industry studied. The last four, however, depend to some extent upon the industry's investments. Given the conditions of supply, the higher past prices of materials and equipment have been and current prices are, the more cheaply is it likely that any given amount of these factors can be secured; for in this event, the prices reflect a large demand in the past and there is, therefore, greater likelihood that suppliers are prepared for a large output.

In the same way, large past employment and high wages will for a time in the future mean relatively cheap labor for the industry. And the productivity of the labor hired is probably sensibly affected by the security which the workers feel. This too turns on the amount of employment which an industry offers.

These propositions must be modified to the extent that suppliers' and workers' current anticipations of the future change in the light of the actual investments being currently attempted by the industry.

Finally, we must take account of current stocks of materials, parts and equipment. The larger the quantity of these remaining

over from past periods, the cheaper, other things equal, is current production. But the larger the amount of equipment of a certain type remaining, the less additional revenue will an increment or investment in equipment promise. This last proposition is based upon the assumption that in most situations the effectiveness of additional equipment in reducing marginal costs becomes smaller as the quantity of the equipment installed becomes greater.

This discussion does no more, perhaps, than present the factors upon which the results depend. To do more at this point would mean a much longer and more detailed discussion than an essay of this general character can include. But in Chapter VIII, the revision of the standard made necessary by a particular set of investments in a particular situation will be attempted.

9. UNCERTAINTY AND THE STANDARD.

The "correct" pattern for investments of various kinds is given by movements of the marginal revenue and marginal cost of these investments. These movements are themselves derived from the assumed changes in the conditions of demand and cost, the reactions to which we wish to study. The marginal revenue and marginal cost of investment are, in this picture, definite quantities, objective facts. They are, for our purposes as an investigator, certain, not more or less probable quantities.

To an investor, however, future events are always more or less probable, so that even if his "rough mathematical estimate" of the marginal revenue from investment at a certain moment were correct, nevertheless, he would not treat investment at this time as promising such great receipts. He would feel that the occurrence of the events he expects is more or less uncertain and he will discount their occurrence "for caution."¹⁴ The extent of this discount will depend upon the degree of uncertainty which he feels attaches to his estimates and upon his attitude towards risk-bearing.

¹⁴ See Chapter IV, above.

One must, therefore, expect certain discrepancies between the correct pattern of investment and the actual course of investment even when investors' predictions of monetary costs and receipts exactly correspond to what the future has in store for them.¹⁵ Now it is necessary to see that these discrepancies stand in a different case than those due to other causes: errors in the forecasting of future income and interest rates, for against investors' feelings of uncertainty and attitudes towards risk-bearing, there are no objective elements to be set. They are subjective states which must be accepted as "real costs" but which can hardly be compared with any valid norms. For example, in so far as the caution factor depends on sentiment with respect to risk-bearing, there is no possibility of investments being "wrong." One cannot be mistaken about one's tastes and distastes, at least at the moment of experiencing them.

Similarly, it does not seem valid or useful to think of investors' judgments of the "uncertainty" of their predictions as being more or less correct. For to the student, the monetary marginal costs and marginal revenues of investment in a defined situation, when appropriately discounted for futurity, are by hypothesis certain values and no other. They are not more or less probable values. In this case, one must look at investors' judgments of the degree of uncertainty surrounding his predictions as subjective estimates which have no objective counterparts. Hence it seems best to treat these estimates as unassailable, in the same way as it was decided above to treat an investor's taste or distaste for bearing the uncertainty.

Business men react to uncertainty not only by assessing a "caution factor" against their estimates of probable future income. They also take action to reduce the uncertainty present.¹⁶ These actions follow three lines. One line is that of in-

¹⁵ This is the same as saying that, *so far as these considerations go*, one must expect a regular emergence of profits; just as discounting for futurity leads one to expect the regular emergence of positive interest.

¹⁶ See Ch. IV, pp. 81-82.

urance; a second is the adoption of methods of production which involve relatively low fixed charges, but relatively high operating costs; and the third method is the postponement of investment while further information is awaited. But none of these dodges are completely comparable with a standard of correctness.

One can assess the probability that one of a *group* of similar firms will suffer an insurable misfortune. But there is no assessing the probabilities for an individual small firm considered by itself. Hence if a firm considers a certain insurance premium worth while, that valuation must be accepted once for all.

Similarly, the argument adduced above in the case of "caution factors" is applicable to business men's decisions to suffer high operating costs in order to escape high fixed charges. It is a decision taken for caution and is caused by feelings of uncertainty and aversion to suffering this uncertainty. Since we can make no hypothesis concerning any *real* uncertainty present, there is no standard by which such actions can be criticized.

The method of delay, on the other hand, is to a certain extent comparable with a standard. The delay of commitments is more or less worth while, depending on whether the information awaited appears in the degree expected. If sufficient data existed, some hypothesis could be constructed concerning the degree to which in different periods relevant information concerning business becomes available. Such data, however, are not to be found and the point must, therefore, be neglected. In any case, the value of this information to the business man depends in part on his dislike of the uncertainty he feels without it.

10. CONCLUSION.

There have now been prepared the devices which will make it possible to analyze significantly the actual investments of an industry over a period of change. By the methods presented in earlier parts of this chapter, it is possible to derive from a given set of changes in the conditions of demand for a product and

of the supply of factors for its production, curves showing the marginal revenues and costs of investment of various amounts at different stages of a period under analysis. The points where these curves cross indicates the "standard" investment for each date.¹⁷

The immediate determinants of actual investments, however, are the anticipations of business men. It was pointed out above that if every firm expects the very prices to rule which would result if the standard plan were followed, and if each firm correctly estimated from these data its marginal costs of production, the industry's investments would, in fact, follow the standard pattern. But if other anticipations are harbored, then, provided these be known, an observer can predict how the actual investments will differ from the standard.¹⁸ If there be such a difference—in general there would be¹⁹—this can be described in terms of a difference between the marginal revenues and marginal costs of investment. If such a discrepancy arises, it makes necessary a revision of the standard for the remainder of the period. For we have seen that the conditions of demand and cost are determined in part by an industry's own investments; and the original standard assumed that investments were correct at every date. But the discussion of sections 6-8 of this chapter suggested how this may be done. Actual invest-

17 A necessary assumption for the validity of these curves, not heretofore mentioned, is that any given output is always produced by those firms to whom the differential cost of production is least and to whom the differential revenue from investment is greatest. This, of course, will never be strictly true. The result is that even if that amount were invested which the curves indicated to be standard, nevertheless some firms would find that the differential costs and revenue from investment turned out to be unequal. This fact, however, will be neglected—as it was in the stationary state method.

18 By use of the methods of Chapter VI.

19 The difference here expected is one *in addition to* the regular difference between actual and standard investments which arises from investors' discounts for caution, a difference neglected in this analysis. The discrepancy with which we are concerned is one due to mistaken expectations which take the form of incorrect "rough mathematical estimates of the future."

136 PRICE THEORY FOR A CHANGING ECONOMY

ments may then be compared with this revised standard at a second stage, and so on.

The critical part of this program, not yet discussed, is the derivation of business men's anticipations. Chapter VIII is an experimental attempt to apply the methods of analysis here presented.

CHAPTER VIII

COMPETITIVE PRICES OVER A BUSINESS CYCLE

THIS final chapter will attempt a demonstration of the theoretical apparatus in operation. It is proposed to investigate the adjustment of an industry's investments in fixed plant to the cost and demand conditions typically experienced over the course of a business cycle.

The study will involve the following steps. There will first be summarized an authoritative description of the course of a business cycle. We shall take it that this description fairly represents the conditions typically faced by business men in an upswing and downswing of business. These data will provide the information necessary to trace the movements of the marginal revenue and marginal cost of investments of various amounts in so far as these are affected by conditions external to the industry. It will then be possible to derive a standard plan of investment for different stages of the period. From the business cycles data, too, it will be possible to argue that the actual investments made are likely to be different in various ways from the standard investments in the various stages of the cycle in question. This makes it necessary to alter our notions of the "correct" pattern of investment. The process of correction will follow the suggestions to this end made in Chapter VII, and it will be with this revised standard that actual investments will be compared. This comparison leads immediately to conclusions that at certain stages of the cycle investments are such that their marginal costs are greater than their marginal revenues, and that at other stages the reverse is true.

Now this discrepancy is due to the anticipation by the members of the industry of prices and of expenses of production other than they would have experienced had the standard plan been followed. From the character of the discrepancy it is

possible to form a very tentative hypothesis of the character of the anticipations of business men and to relate these anticipations to their past experience.

1. THE CONDITIONS OF THE PROBLEM.

The industry to be studied is to be thought of as a manufacturing industry producing a semi-durable consumers good for sale to wholesalers and large retail buyers. It is an industry in a "mature" stage of development. By this we mean that its output has been increasing from decade to decade at a decreasing rate of change.¹ Within each decade, it experiences at least one and generally more cycles of relatively good and bad business² which involve fluctuations in production.

The most general and significant characteristic of these trade cycles is that they are complex combinations of differences with similarities.³ The point may well be developed. Cycles of good and bad business recur in which the order of events is broadly repeated from one occasion to another. But the duration and amplitudes of the swings differ and serve to prevent anything like accurate prediction. Moreover, the longer time develop-

1 A. F. Burns, *Production Trends in the U. S. since 1870*. Almost every industry studied by Prof. Burns was characterized by a rate of growth of this sort. We may take it as typical of industries after a relatively very short period during which growth may be at an increasing rate.

2 The industry is also typically experiencing from decade to decade conditions making for faster and slower growth. (See Prof. Burns' discussion of "trend cycles," *op. cit.*, p. 174 *et seq.*). But this seems, by comparison, a relatively minor aspect of the problem now at hand and will be neglected.

3 W. C. Mitchell, and A. F. Burns, "Production during the American Business Cycle of 1927-1933," *Bulletin 61*, of the National Bureau of Economic Research. Professors Mitchell and Burns write:

"Every business cycle of which we have definite knowledge presents features that are peculiar to itself and features that are common to its species . . .

"In so far as a cycle develops unique features the statistician's forecasts are likely to go wrong, the business man's plans may miscarry and the economist's explanations need supplements or revisions. . . . Also, the more a given cycle deviates from expectations based upon past experience, the more mistakes are men likely to make."

ments in specific industries serve to blur the effect of the cyclical component of events in the view of the business men concerned. The business man, therefore, will not only miscalculate the cyclical swings of business, he will often lose sight of them entirely.

The chief characteristics of a typical business cycle, from which it will be possible to derive the course of cost and demand conditions,⁴ may be secured by interpretation from Professor Mitchell's "analytic description" of business cycles.⁵

Prof. Mitchell begins by pointing out that the routine phases of cycles are subject to numerous exceptions.⁶ These exceptions he appears to believe are largely to be explained from the evolving nature of cycles, from the different conditions to be found in different countries, and from the impingement of random influences upon the course of events. The exceptions noted and their explanation enforce the conclusion that the description of cyclical movements presented is viewed by Prof. Mitchell as compounded of features which are typical of business; and we shall treat it as such.

Prof. Mitchell divides a complete cycle into four phases: revival, expansion, recession, and contraction. Each of these phases grows naturally out of the phase preceding and presupposes the preceding phase as an explanation of the development. Thus any phase taken as a point of departure is arbitrary, and the explanation of how the conditions of the phase with which the description begins came to be can only be answered as the last step in the process.

We shall begin with the phase of revival.⁷

⁴ In so far as these conditions depend on factors external to an industry.

⁵ W. C. Mitchell, "Business Cycles," *Encyclopædia of the Social Sciences*, Vol. 3, pp. 92-106.

⁶ *Op. cit.*, p. 101.

⁷ Prof. Mitchell takes this as the last phase; but it seemed most convenient to present it first because it is proposed in later sections of the chapter, to present business men's adjustments to the revival of demand first and to follow his actions through the phases which follow.

When this phase opens, interest rates are relatively very low. Indeed, it is noted that call-money rates sometimes fall so low that gilt-edge bonds may be bought with borrowed funds. The possibility of borrowing so cheaply causes a rise of stock and bond prices. This is viewed as "encouraging."

At the same time labor costs are low. Wage-rates have fallen and the less efficient workers have been discharged. Equipment may be bought cheaply and deliveries are prompt.

Purchases of goods increase for several reasons. Consumers with reserve funds or incomes are finding it more and more important to replace worn goods. And any check in the rate of decrease of consumers' purchases will cause retailers to increase their orders for the purpose of building up stock. At this time, too, employment and, therefore, consumption begin to revive as durable producers' goods for maintenance, replacement and planned additional equipment begin to be bought. Finally, it becomes apparent that in many lines, the process of falling prices which has characterized the preceding phase has come to an end. In many places, prime cost levels have been reached. Business men who have feared to buy lest prices fall still further, subjecting them to inventory losses, now appear in the market and add to the growing demand.

This picture of low, but stable cost prices together with very low interest rates and the turn in demand and employment brings in its train a slow return of business confidence, which aids in the recovery process and brings us to the second phase.

The phase of expansion is a period of rapidly rising demand for goods. There are no data bearing on the rate of increase of demand,⁸ but it seems plausible to suppose that at least over part of the phase, the increase proceeds at a decreasing rate. The demand for clothing, shoes, and more durable consumers' goods at various prices may increase first fifty per cent and then one hundred per cent, but this process must soon reach a limit and further increases take place at a decreasing rate.

During the first part of the period, prime costs per unit remain low. Wage-rates do not rise quickly, nor does a scarcity of labor appear. Presumably even where the machine capacity of plants is

⁸ This is clearly not the same as the rate of increase of production.

reached, additional shifts of workers may be organized without large increases in costs. Profits are, therefore, large.

A desire to expand plant now makes itself apparent and with the prices of shares advancing, the capital market is favorable for new issues. And where companies are not large enough to be able to raise capital in this fashion, current profits together with private savings provide the funds. Investments in capital equipment become heavier as the phase progresses. Interest rates on bonds and other money rates, however, are rising during the period.

Commodity prices, unlike the price of labor, begin to rise, and this rise, far from discouraging demand, often leads to more rapid purchasing. The reason is that the customers fear the possibility of higher prices in the future. This makes current production both for sale and inventory all the more profitable.

The sentiment of business men becomes definitely optimistic, and they tend to view the future in a more and more sanguine fashion as the period proceeds.

This phase of the cycle gradually gives way to a third period, called by Prof. Mitchell the recession. As demand and production increase costs which have hitherto risen only slowly begin to mount rapidly. They do so for a number of reasons. Wage-rates and raw materials prices rise rapidly under the impact of eager competition. The supply of labor still to be drawn into employment is relatively untrained and is generally of poorer quality than those men already at work. And efficiency is adversely affected also by overtime work, the general rush with which business is done, and by the decreasing effectiveness of discharge as a disciplinary device.

Costs of production mount also because many plants reach their "practical capacity." We may infer from this that further extension of production involves rapidly increasing differential costs due to overcrowding and the use of sub-standard equipment.

These conditions act as a mild check on profits, but many firms order capital equipment in order to lower their costs, particularly since demand at the beginning of this phase is still rising.

As the phase progresses, however, demand ceases to increase in many lines of business. For this, there are many reasons. Employment is adversely affected by the discharge of men employed in

producing and installing equipment which now needs only maintenance. And the "principle of acceleration" now begins to take its toll of employed men in both producers' and consumers' goods lines. Demand for equipment slumps most sharply in industries where managers realize that their orders and plans for additional equipment are already in excess of requirements.

This slump of demand is aggravated by the fact that the first failure of demand to increase is accompanied by a halt in price increases. Then the demand which was motivated by a fear or hope of higher future prices disappears from the market.

During the period, too, there is a rapid rise in interest rates. The phase opens with sharp competition for funds at a time when bank reserves are strained to the limit of the banks' notions of safety (if not to the legal limit) and bank indebtedness to reserve institutions is relatively high. At the same time many firms reach their practical borrowing capacity and must depend on their own profits for additional working capital and fixed capital.⁹

As the money rates mount, the new issues market, which had been favorable to this point becomes tighter.

Finally, the optimistic and buoyant tone of business sentiment slowly begins to turn under the influence of lower operating profits and of the disappointment of the more glowing hopes of the past. This turn of sentiment feeds upon itself. As it affects more business men, they take the actions which provide the solid ground for their more pessimistic predictions. Their cancellation of orders, and reduction of production means a general fall of demand which grows by the unemployment it creates. The stage is now set for the fourth phase: contraction.

This last of Prof. Mitchell's periods is presented as a stage which in general repeats in reverse the characteristics of the period of expansion. He notes, as of special importance, that the declines in demand and in prices vary in severity with the distance of the industry from the production and distribution of consumers' goods; and that bond prices generally rise.

⁹ In terms of the argument of Chapter IV, above, the marginal cost of borrowing to many firms climbs above their marginal rate of time-preference and henceforward it is this latter rate which is relevant in discounting future costs and receipts.

The declines in prices, in interest rates and in labor costs, the gradual decline in the usefulness of producers' and consumers' equipment over the period furnish the conditions upon which the revival is built.

This completes the description of the relevant characteristics of cycles. The plan of the chapter now is to investigate the investments of business men in these circumstances to see how well the results of their actions compare with a standard plan of investment for the period. We shall confine the discussion to investments in fixed plant. Before this analysis is begun, however, it will be convenient to say something of the discount factors used, and of business men's judgments of the uncertainty of the results of their actions.

2. DISCOUNT FACTORS OVER THE COURSE OF A CYCLE.

The movements of interest rates were described above. These, however, do not determine the discount factors which business men apply. For investors must consider not only current but also future rates of interest. And if they neglect the latter or make mistakes about them, they will fail to plan their investments correctly.

The analysis of Chapter IV, above, indicated that if expected marginal receipts from lending were below the expected marginal costs of borrowing, the discount factor applied by business men to their investments would lie between these limits. It was further shown that the relevant figures to be used in computing marginal costs and receipts were, for investments of given maturity, either the product of the expected short-term lending rates or the current long-term lending rate, whichever was higher, and the product of the expected short-term borrowing rates or the current long-term borrowing rate, whichever was lower.

Now the fact that people have an option of lending or borrowing at short-term means that (if they be borrowers) they need never assess against future receipts and costs such high interest rates as they would need to pay for long-term

loans at the upper peak of a cycle. For they ought to expect to be able to secure lower rates in a short time. Similarly, people with surplus funds ought to figure that their money must earn something more than the rate at which they can lend during the trough of a cycle. For they ought to expect higher rates in the near future.

One has the general impression, however, that these opportunities to escape unfavorable long-term rates are not utilized to the full. Many companies consider that future interest rates are too uncertain to finance a long-term project with short-term money, even temporarily. Business men's neglect of short-term money rates is, however, due in good part to errors of prediction. In the prevailing optimism of the upswing—when interest rates are high—many business men do not anticipate lower rates in the calculable future. To the extent that this is so, it may be said that borrowers discount the future too heavily during that phase of the cycle when interest rates are high (the early recession phase).¹⁰ In the same stage, investors with their own cash to commit would be right in discounting the future by at least the favorable long-term rates.

In the early stages of an upswing, when interest rates are low, the case is just the reverse. Now, of course, those who must raise funds by borrowing are right to discount the future by the (low) rate of interest on long-term funds. But those who have surplus funds are likely to use the current lending-rates as a discount factor. They would fail in the post-recession gloom to anticipate the upturn in interest rates soon to appear. And this would be a costly error, for they might have lent at short-term and so kept their funds free for longer-term lending at more favorable rates.

There is then some reason to believe that in the revival phase of a business cycle, the discount factors applied in planning

¹⁰ This statement has an air of paradox. It does not mean that business men are not optimistic about the future in this stage. They are; but for precisely that reason they do not foresee that interest rates will soon be lower.

investments are somewhat too low, in so far as investments are made from surplus cash—as many investments are in this stage. On the other hand, in the early recession period when interest rates are high, it seems likely that investments made on borrowings are discounted at too high a rate. Both errors reflect the prevailing mood of the period, the one dull, the other sanguine.¹¹ To the extent that the first is true, the marginal cost of investment tends to be greater than its marginal revenue. To the extent that the second is true, marginal revenue tends to be greater than marginal cost.¹²

3. DISCOUNTS FOR UNCERTAINTY OVER THE COURSE OF THE CYCLE.

The degree to which people discount anticipated income depends upon their judgment of the degree of uncertainty¹³ present and upon their attitude towards risk-bearing. Both these elements probably vary over the course of a cycle; and they probably vary in the same direction. As the cycle moves upward, one's impression is that people feel that the rough distribution of probabilities about their average expectation is narrower. During this period too as profits and reserves have been improving, people's aversion to risk-taking probably decreases. At or near the peak of business, investors apparently become more

¹¹ Note that these judgments apply only to the discount for futurity. Of course, people are much less hopeful in the revival about the profits to be secured from investment than they are near the upper turning point of a cycle.

¹² Nothing is said at this point about people who raise capital by selling equity shares. The problems of whether to invest and whether to sell shares are distinct. If the shares are sold, the alternatives of investing and lending are the same as for any one with surplus funds. Whether to sell shares or not depends on the selling price of the shares and the earning capacities of the new capital either in loans or investments. It may be wise at the peak of a cycle to sell shares, but to hold the money at interest until the depression or the next revival is under way.

¹³ This uncertainty might be represented, as was suggested in Chapter IV, by the shape of the rough probability distribution of prospects which investors have in mind. The greater the feeling of uncertainty, the greater would be the deviation of probabilities from the mean.

uncertain about their predictions, the range of possibilities widens. Probably aversion towards risk-taking does not begin to increase until later when losses become overt and are realized. At the bottom, again, it seems a plausible guess that the confidence of people in their estimates begins to revive before their distaste for risk begins to diminish. For the latter is probably a function of the existing *state* of income and reserves rather than of prospects for the future. This has a particular bearing for the state of mind of investors at the bottom of a cycle. For at this point reserves are very low. In consequence, a mistake may mean bankruptcy and not only the loss of the additional investment.¹⁴

None of this argument concerning the movements of the caution factor and its determinants, however, can lead to judgments about the probable effect of these movements upon the relation between the marginal cost and marginal revenue of investment. It was pointed out in Chapter VII that these elements were completely subjective to the investors and that no objective counterpart exists against which these subjective elements can be assessed.¹⁵ It is best then to treat these judgments as unassailable and we conclude then that the correctness or incorrectness of investments does not depend on the caution factor applied or upon the types of investments inspired by caution. "Correctness" depends only upon the "rough mathematical estimates"¹⁶ made by business men of additional receipts and costs of investment and upon the discount factors they use. The relation between the discount factors used and the "correct" discount factors has been discussed in section 2 of this chapter. With this in hand we may now outline a standard pattern of investments and contrast this pattern with that actually found.

¹⁴ I have this suggestion from Mr. M. Friedman. The point is also made in the article by A. G. Hart, "Anticipations, Planning, and the Cycle," *Quarterly Journal of Economics*, February, 1937.

¹⁵ See pp. 132-4, above.

¹⁶ See Chapter IV, above.

4. THE STANDARD PLAN OF INVESTMENT OVER THE CYCLE.

We are dealing with a growing industry, in which the conditions of supply and demand call for an expansion of output.¹⁷ Investment in fixed plant is, therefore, required sooner or later, either for the replacement and extension of plant similar to that already in use or for the substitution of improved, more productive machinery for older types. The question then concerns the rate and timing of investment. In considering this question, two things must be borne in mind among others. A favorable opportunity to invest later is a cost of investment at any particular time to the extent that current investment makes future investment less profitable. Similarly, if current investment in fixed plant makes current production less profitable, by upsetting temporarily the organization of a plant, this is likewise a cost of current investments.

(1) The correct course of investment in the absence of the fluctuations in demand, costs, and prices which characterize a business cycle.

The assumption of growth in quantity of output at a declining rate of increase is consistent with many rates of change in the quantity of investment in fixed plant per time period. In order to make any definite hypothesis, assumptions must be made with regard to changes in demand, in the prices and efficiency of labor, capital funds, capital equipment and technical capacity of mechanical equipment. The assumptions which lead to the simplest result are that only the demand for the product is changing; and that this element is growing at a declining rate. In this case, we could conclude that the absence of business cycle fluctuations would call for continuous, but always smaller, net additions to capital equipment.

Whatever assumptions we make, however, it seems clear that in the absence of business cycle fluctuations in demand and costs, a virtually steady rate of net new investment would be indicated over any forty months' period studied.

¹⁷ See p. 138, above.

(2) The "correct" course of investment in fixed plant over a business cycle.

In reality, demand and cost conditions do not change at a steady rate but according to the business cycle pattern described in section I of this chapter. Given this pattern as a condition to which business men must adjust, it would not be correct for investments to be made at a steady rate over a cycle. Rather a balancing of considerations indicates the advisability, from the point of view of entrepreneurs, of concentrating their investment in the stages of late contraction and early revival.¹⁸

This can be shown by considering the movements of the various factors affecting the marginal revenue and marginal costs of investment over the course of a cycle. The investment of funds at a particular time is, in the view of a business man, only the first of the income items, positive and negative, which he conceives are probably involved in the decision to invest. Most of these items will, in the case of investment in fixed plant, occur beyond the limits of the cycle now in view (starting from the beginning of revival).¹⁹ These items (according after the conclusion of the cycle under consideration) will be the same no matter when, during the current cycle, investments are made, provided the same total amount of investment is undertaken. Furthermore, if the equipment in question is installed before the downswing of the current cycle begins, it must face this

¹⁸ The argument above proceeds upon the assumption that we are dealing with a single industry whose significance for the economy as a whole is not great. The standard proposed in the text with regard to the timing of investments is not applicable to all industries at once. For if all industries concentrated their investments in "early revival," this phase would be "early revival" no longer. It would be something like "late expansion"—and again the business men's investments would be incorrectly timed.

The moral is that one cannot offer the same investment policy to all business men as individuals and advise them to follow it together. For acting together they change the conditions in the light of which the advice is offered. The problem of defining a standard of investment for all industries together is a problem of another order entirely.

¹⁹ The items will consist largely of expenditures for and receipts from the production of goods.

period of low or negative net income items no matter when over the course of the upswing the installation took place.

The profitability of investments made within the cycle under review depends upon their total quantity and the timing of the investments, the movements of costs and demand being given. And as will become apparent, the questions of the quantity and the timing of investments cannot be wholly dissociated. Consider the question first on the assumption that the expenses of building and installing equipment as well as the "incidental costs of investment"²⁰ and the appropriate discount factors do not change over the cycle. The cycle under consideration is then a cycle only of movements of demand. Then the problem of how much to invest and when to invest may be easily solved.

It may be validly urged that the total volume of investment over the course of the cycle ought to be about the same as would be indicated if demand were increasing steadily instead of in the business cycle pattern. For the period of high demand in the upswing will be balanced by the period of low demand in the downswing, and the average demand will be that indicated by the trend of long-time development.

The question of timing still remains and may be settled by the following argument. If there are no differences in the costs of investment at different times (the possibility of such differences is here temporarily disregarded), it is clearly unwise to have additional equipment installed before it can be used to increase the receipts of the firm. For before this time, the investment represents a loss of interest which is not offset by receipts. Receipts may be increased by additional equipment whenever this equipment acts to reduce the marginal costs of producing current output. The installation of machinery, whose investment in the long run is profitable, is indicated at the point at which the additional net receipts made possible by reason of the reduction of marginal costs of the production of current

²⁰ See above, Chapter V, p. 99.

output is equal to the interest being currently lost because of the additional investment.

How soon, in a cycle, this point is reached for any item of capital equipment depends upon (a) the rate at which the old machinery is being used, and (b) the degree to which the new machinery represents an improvement in technical efficiency. Machinery which is a mere duplicate of the older, already installed types and machinery which is an improvement over these types represent somewhat different problems. If one considers first units of plant which are technically no more efficient than the units already available, these do not begin to bring in revenue until the previously available units begin to be crowded, that is, until marginal costs of producing with this machinery begin to rise because of the rate of utilization alone.²¹ So far then as the possibility of idleness is a factor making investment less profitable, it begins to disappear as soon as the available machinery becomes at all crowded (defining "crowding" by the marginal costs' criterion, as above). This should occur quite early in the cycle. The first additional units put in would reduce marginal costs, which would again begin to rise as output increases, making it profitable to use additional machinery. After a time, which should be sometime before the peak of the cycle, it would no longer be wise to add additional equipment. All the investment indicated for this cycle would have been installed. But it is not possible to say how long before the peak of output, this point would be reached.

This may be put in another way. As the peak of the cycle approaches, it becomes more and more likely that positive advantages from delaying investment will appear,²² for the chief reason not to delay is the income foregone because the machinery is not available until later. Near the peak of the cycle, however, the incomes foregone between then and the next upswing are zero or even negative.

²¹ Increases in wage rates, etc. must be here neglected, for they would apply both to the older and the newer machinery.

²² See Chapter V.

This schedule of investments is pushed forward, however, to the extent that the new equipment is more efficient than that already in use. New machinery may be technically more efficient than old machinery either because it represents improved design, or merely because it is less old than the already installed equipment. In either case, investment can result in a lowering of the marginal costs of current production even before the rate of output increases and "crowds" the older equipment. Hence the investment of such machinery is profitable at an even earlier date than was indicated for equipment which is a mere duplicate of that existing.

Let us now turn to the influence of cyclical fluctuations in the costs of investment, still assuming that the discount factor which is appropriate remains constant over the cycle. These costs consist, first, of the expenses of building and installing the new equipment and, secondly, of the "incidental" costs of investment. The latter are caused by the loss of current business due to the interruption or disorganization of production while new equipment is installed.

Fluctuations in these costs follow a similar pattern. Building costs are lowest in the trough of depression and remain low during the revival phase. They climb slowly and are at their peak close to the peak of the cycle itself.²³ The "incidental costs" of investment in fixed plant depend on two factors: the amount of current production which is made impossible by the improvements or installations involved, and the net earnings lost per unit. Current production lost in this manner probably increases throughout the period of expansion. For the degree to which the process of installation or repair involves interruptions to current work would seem to depend on how nearly full a plant is running. This would point to the peak of the cycle as the peak in "incidental costs". But it is not so easy to say how the second factor—net earnings lost per unit—behaves.

²³ See J. M. Clark, *Strategic Factors in Business Cycles* (New York, 1935), pp. 50-51.

While it appears to be true that business earnings are usually less satisfactory at the peak of an upswing than somewhat earlier, one cannot conclude from this that the earnings per unit to be lost by a reduction of production reach their peak before the turn of the cycle itself. On the basis of the information at hand, no guess about this latter point is possible.

These cost movements influence both the amount and timing of investment which is "correct". If there were no fluctuations in costs, we might assume that investments would be made at about that cost figure which would be gotten by averaging the actual costs over the cycle. On the basis of this stable cost figure, a certain volume of investment would be justified. Actually, investors may take advantage of costs which are below the average. Hence a larger volume of investment is justified.

Fluctuations in cost also affect the timing of the investments. If savings in the cost of investments may thus be obtained, it is worth while to install equipment even before it can be put to profitable use. That is, it is worth while to install the equipment, before its use can increase the net earnings from *current production* by as much as the interest receipts lost by sinking funds in plant. The low costs which characterize the trough and revival stages promise substantial savings of this sort, and this suggests that investments ought to be made at an earlier stage than the movements in demand would themselves justify.

As the cycle progresses towards its peak, the advantages of postponement become greater than they did when it was assumed that there were no fluctuations in cost. For now, not only does a period of low or negative incomes loom because of the impending decline in demand; there are also substantial savings in the cost of investment to be had by waiting until the bottom of the next depression.

This argument is further reinforced by consideration of changes in the discount factors appropriate to investment in different stages of a cycle. The discount factor which ought to be applied in the early revival phase is for most people lower

than that which they ought to apply later in the cycle. Borrowers can at this time secure long-term funds more cheaply than they can later. Investors with free cash are faced with long-time lending rates which are lower than they will be able to secure later. If they take account, as they should, of the possibility of lending at short time temporarily, this tends to bring their minimum discount rate somewhat nearer the point which it will reach later in the cycle. Later in the cycle lenders will be able to dispose of long-term funds at rates which will cause their discount factor to rise. Borrowers ought to raise their discount factor as the cycle proceeds, for they too will have to pay more onerous rates for money than they would in the early upswing even if they borrow on short-term and take account of the fact that the high rates are temporary.

The movements of the appropriate discount factors are then additional reasons for investing funds early in the cycle. And like the fluctuations in costs, these movements also justify a somewhat greater volume of investment over a cycle than would be justified by constant lending and borrowing rates.

There is a final reason for concentrating investment early in the upswing. This is the fact that purchase, construction and installation take time. In order to take advantage of the low costs of the trough and early upswing and of the high demand which follows, investment must be initiated early.

The argument of this section leads to the conclusion that the "correct" course of investment in fixed plant over the course of a cycle calls for a great deal of investment early in the upswing—perhaps beginning before the upswing in general business—with a peak in the rate of investment in the revival or early expansion phase and complete cessation of investment long before the peak in general business. This schedule of investments presumes that the optimum volume of funds is invested on every date. If, for example, less than the best quantity of funds is committed on certain dates then two results follow. In the first place, a smaller total volume of investment becomes justified for the current cycle; for if the same total

might still justifiably be invested, our argument above should have indicated that it was a matter of indifference when investments were made over the cycle. On the other hand—this is the second result—it seems likely that failure to invest the best amounts early in the cycle must cause the schedule of investments to be pushed back in time somewhat so that the date of complete cessation falls at a later stage. This is likely to be true because the marginal revenue from investments in fixed plant on any given date depends in part upon the quantities already invested. If less than the best amounts are installed on certain dates, this acts to raise somewhat the marginal revenue from investment on later dates and, therefore, to delay the date on which the relation between the marginal costs and marginal revenues from investments justifies no further commitments.

In the same way investments of more than the best amounts on any given date must have analogous results. The total of justified investment is reduced and the date of complete cessation is pushed forward so that it falls on an earlier date. In other words, a failure to invest the optimum amounts on any date necessarily causes the schedule of correct investment for the remainder of the cycle to be revised.

When less than the "correct" amount for a given date is invested, we shall say that marginal revenue from investment is greater than marginal cost. But the "correct" amount must be understood as defined by the actual investments previously made. And with the same understanding we shall say that marginal costs are greater than marginal revenue when investment outruns the correct amount for a given date. In terms of the argument of a previous chapter,²⁵ our ideal schedule of investments presumed that marginal revenue and marginal costs were effected by factors external to the industry and by the "best" responses of internal factors. But in tracing the actual course of investment over the cycle, we must take account of the fact that the optimum investment is not made at all points

and that this changes the amounts of investment which are justified on later dates.

5. THE ACTUAL COURSE OF INVESTMENTS OVER A BUSINESS CYCLE.

The actual course of investments in fixed plant over a business cycle is well-known. It conforms almost exactly to the movement of business in general. Its trough is coincident with the stage in which business is at its lowest; its peak, with the stage in which general business is at its highest. The evidence to support this proposition is plentiful;²⁶ and were it not typically true of business, trade cycles would not have the pattern they do have. The peaks and troughs of business in general are necessarily connected with the fluctuations of investment in fixed capital. The one induces and feeds on the other and neither could exist alone, at least not in the way with which we are familiar.

For any given industry, however, the movements of business in general are datum—fluctuations to which adjustments must be made in the most profitable fashion. For any given industry to follow the typical pattern represents a mal-investment of capital, in so far as this pattern is the result of errors of judgment alone. In so far, the evidence indicates that at the trough of general business, investments are so limited in volume that its marginal revenue exceeds its marginal cost. As the upswing proceeds, the volume of investment grows and continues to increase to the peak of general business itself. At this point, investment is surely such that the original relation of cost and revenue is reversed: now marginal cost is greater than marginal revenue. This is probably true even though the low levels of

²⁶ See, for example, J. M. Clark, *Strategic Factors in Business Cycles*, pp. 27-53, and Appendix, pp. 228-231. Of all investment in durable goods, construction shows the most marked lack of conformity with the general cycle, expressed in a pronounced tendency to lead. But the general construction index is strongly influenced by the residential construction component. Industrial construction indicates a small lead at the upturn, but no lead at the downturn.

investment act to move back the date at which investment ceases to be profitable. For surely if business men could foresee the drop in demand and in costs soon to ensue, they would prefer to delay commitments until the costs of investment were lower and the prospects of active demand much closer in time.

The failure of the actual pattern of investment to conform to the ideal pattern described above is not, however, due to errors of judgment alone. It is dependent in part upon feelings of uncertainty with respect to predictions concerning the future and upon the degree of distaste which people have at various times for bearing uncertainty.

Our argument above²⁷ led to the conclusion that business men's distrust of their judgments and their aversion to committing funds to an uncertain future are both at their peak when the state of general business is near its lowest point in a cycle. Similarly, both are weakest when business is near its highest point. It is, therefore, necessary to recognize that a relatively large share of responsibility for the discrepancy between the actual and ideal patterns of investment must be assessed against the cautionary restraint of investors at a cycle's low point, a relatively small share at a cycle's high point. The cause of the discrepancy at the cycle's low point is partly bad judgment and partly fear of, and aversion to, uncertainty. At the cycle's high point the discrepancy may be laid almost entirely to bad judgment. In so far as the cause of the discrepancy is not bad judgment of the future, nothing can be said of the relation between marginal cost and marginal revenue. This is a serious limitation upon the analysis in the early stages of the upswing of business. It becomes less important as a cycle approaches its peak.

It is tempting to present an hypothesis to explain the bad forecasting which is probably present. The one which must force itself upon almost any observer is that typical business men judge the future by the recent past and extend into a more

²⁷ See pp. 145-146.

distant future the trend of events recently experienced. This hypothesis is quite consistent with the observed pattern of investments, on the one hand, and with the conditions of supply and demand on the other.

Expressed in this broad fashion, it probably would be denied by none; and the present writer is, as yet, without resources to push it further. But clearly what is required are lengthy and detailed statistical studies of the volume of investments in given periods and the movements of relevant prices, costs and interest rates which preceded those periods. And further correlations would be useful: of investments and the volume of sales, inventory, stock-market averages and other indices of business conditions which investors use as omens of things to come.

The tendency to poor forecasting over a business cycle, noted above, is aggravated by one factor and alleviated by another. It is aggravated by the fact that emotional states probably affect our interpretation of reality. Even if people were emotionally neutral over a business cycle, their lack of knowledge of the causes and character of cyclical swings would probably cause them to interpret high prices and active buying to mean that similar conditions will exist in the future. But if this pleasant experience causes them to disregard at such times omens of a less pleasant future which may be just as available to them, this makes bad judgment worse. The writer has the impression that some such process actually takes place.

One phase of business men's tendencies to extrapolate existing conditions into the future, however, operates to alleviate somewhat the unfortunate results of their planning. This is in connection with their forecasts of interest rates. The most important consequence of a failure at the trough of business to predict higher rates in the future is that it makes business men content to keep their investments at a low level. But for business men who have surplus funds to invest, this same mistake causes them to discount the future at a lower rate than they would if their knowledge of the future were better. Men with surplus cash discount investments by their prospective earnings from

158 PRICE THEORY FOR A CHANGING ECONOMY

lending in the most profitable fashion. At the trough this is probably a rate higher than the then current rates. For the lenders may put their money out at short term and await higher lending rates in the future. To the extent that they do not recognize this opportunity, they tend to discount the future at too low a rate in this stage of the cycle. The same train of reasoning supports the view that at the peak of a cycle business men who have surplus cash discount the future at too high a rate. To this extent, the total of investments is more likely to approximate the correct pattern than previous discussion indicated.

VITA

THE author was born on Jan. 1, 1912, in Brooklyn, N. Y., and was educated in the primary and secondary schools of that city. He entered Harvard College in 1928 and was graduated in 1932. The summer of this year he spent in Europe on a Sheldon Traveling Fellowship. In the fall of 1932, he began graduate studies in economics in Columbia University and continued his work there until the fall of 1935. During 1934-1935 he held a Columbia University Fellowship. 1935-1936 was spent in Washington and New York as a Social Science Research Council Field Fellow studying price-policies in capital goods industries. During the academic years 1936-'37 and 1937-'38, he was an Instructor and Tutor in Harvard University and in the fall of 1938 he went to the National Bureau of Economic Research to study the cyclical behavior of inventories.

CHECKED
2008-04