

The Theory of Commodity Price Stabilization

A Study in the Economics of Risk

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and
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CLARENDON PRESS · OXFORD
1981

Oxford University Press, Walton Street, Oxford OX2 6DP

London Glasgow New York Toronto

Delhi Bombay Calcutta Madras Karachi

Kuala Lumpur Singapore Hong Kong Tokyo

Nairobi Dar es Salaam Cape Town

Melbourne Auckland

and associate companies in

Beirut Berlin Ibadan Mexico City

Published in the United States by

Oxford University Press, New York

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British Library Cataloguing in Publication Data

Newbery, David M. G.

The theory of commodity price stabilization.

I. Title II. Stiglitz, Joseph E.

338.5'28 HB255

ISBN 0-19-828417-9

ISBN 0-19-828438-1 Pbk

*Typeset by Anne Joshua Associates, Oxford, England
and Printed in the United States of America*

For
TERRY AND JANE

Preface

This book develops a methodology within which alternative proposals for stabilizing the prices of agricultural and other commodities can be evaluated. Many countries – the United States, Britain, and the Common Market among them – have had some form of domestic price stabilization scheme for selected agricultural commodities for a long time, but over the years there have been recurrent proposals for an *international* stabilization programme. The dramatic boom and bust of many primary commodities over the period 1973–5, and the success of OPEC in raising the price of one primary commodity, oil, have again awakened interest in such proposals. The fourth meeting of the United Nations Conference in Trade and Development held in Nairobi in May 1976 proposed an Integrated Programme for Commodities, which, among other recommendations, proposed setting up buffer stocks to stabilize the prices of ten ‘core’ commodities. This renewed interest in price stabilization, and in particular the proposals for price stabilization, provided the direct impetus for the present book.

The studies from which this book has evolved were undertaken at the behest of the World Bank and the Agency for International Development (US AID). When we undertook the studies, we thought it would be an easy task converting the ‘received wisdom’ on commodity price stabilization into a simple model within which the magnitudes of the costs and benefits could be assessed. As our work progressed, it became increasingly clear that much of the received wisdom was incorrect, and that the standard model used in most empirical work rested on such special assumptions as to make it of very limited use.

In retrospect, this should not have been too surprising: a complete analysis of commodity price stabilization programmes requires nothing less than a full general equilibrium model of an economy with uncertainty, but with imperfect risk markets. This is an area of research which – in spite of its importance – has only recently been studied, and which is an active area of current research.

As a result of our attempt to develop this theory and apply it to the problem, we have produced more than just a book about commodity price stabilization. It is a book about the behaviour of economies with risk and with imperfect risk markets, with results which we believe will have a variety of applications in other areas. We believe our results will be of interest to general economists, and particularly economic theorists, who have only limited interest in the specific problem of commodity price stabilization, and to agricultural economists, who have long recognized the importance of risk and have, over the years, made significant contributions to our understanding of economic behaviour under risk.

We have written this book with these three audiences – the policy economists interested in assessing the desirability of commodity price stabilization

programmes, the agricultural economist interested in the development of more general techniques for analysing risk, and the general economist, interested in the general equilibrium analysis of market economies in the presence of uncertainty – clearly in mind. Naturally, the objective of reaching such a wide and diverse audience brings special problems, for each group has different problems in mind and possesses a different background in mathematics and economics. What is a commonplace for one group is not for another: what is a plausible, reasonable, and widely accepted assumption for one may seem totally arbitrary to another. Our solution has been to be inclusive rather than succinct, in the expectation that readers familiar with one section will be able to skim and jump to the next stage, while others who find our approach novel will not need to consult other texts. We therefore expect readers to make intelligent use of the Contents.

To make our book as accessible as possible to as many non-technically oriented readers as possible, we have presented extensive summaries of our results (in Part I) and extensive intuitive interpretations of our analysis in the introductions to each of the other parts of the book, and also in the introductory and concluding sections of most of the chapters. Those chapters which require a somewhat higher level of mathematical skill are denoted by an asterisk. Readers who find particular chapters or sections of chapters hard going – and there will be few who find all of the chapters easy – can skip to the concluding section and then move on to the next chapter without losing the thread of the argument.

As we mentioned earlier, the original impetus for this research was provided by a set of studies we did for the World Bank and the Agency for International Development of the US State Department and we are indebted to both organizations for their interest and support. We would, in particular, like to thank Lorenzo Perez of US AID and Charles Blitzer of the World Bank for their helpful comments on these earlier studies. In the two and a half years over which this book was written, financial support was also received from the National Science Foundation. The first draft of the book was completed in the autumn of 1978 (while Stiglitz held the Oskar Morgenstern Distinguished Fellowship at Mathematica) and was typed by Julia Martinez of Mathematica. Subsequent drafts have been typed by Shirley French in Cambridge and Jackie Rowley in Oxford, and parts have circulated with help from the British Social Science Research Council.

We should like to acknowledge the helpful comments of numerous individuals on various drafts of the chapters of this book, especially: Avi Braverman, Franklin Allen, Gordon Gemmill, Richard Gilbert, Ravi Kanbur, Steve Salant, and Gerhard Wagenhals. Parts of Chapters 17, 18, and 21 have already appeared in the *Economic Journal*, as Newbery and Stiglitz (1979b), and we are grateful to the publishers for permission to include them here. Finally, of course, we should point out that none of the supporting institutions is responsible for any of the views expressed in this book.

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List of Abbreviations and Symbols

ABBREVIATIONS	
AC	average cost
Corr	correlation coefficient
CV	coefficient of variation
Cov	covariance
CS	consumer surplus
EUV	export unit value
IMF	International Monetary Fund
IPC	Integrated Programme for Commodities
LDC	less developed country
log	logarithm
MA	moving average
MAD	mean absolute deviation
MC	marginal cost
SD	standard deviation
Var	variance

SYMBOLS	
\approx, \cong, \approx	approximately equal
\equiv	definitionally equal
$\hat{\theta}$	indicates θ is a random variable
\bar{x}	expected value of x
f', f''	derivatives
t', t''	different dates

A Note on Notation

The alphabet has a limited number of letters, so some necessarily stand for different variables in different places as the following list shows. Random variables are indicated with a tilde, \tilde{q} , where we wish to draw attention to the randomness, but not always where the variable is usually random, like price, p . Expected values, that is, averages, are indicated by a bar, and the expectation operator, which takes the average value of the expression to its right, is E . Thus $E\bar{p} = \bar{p}$ is the average price, $p(\tilde{Q})$ is the price of the average quantity (usually different from \bar{p}). In general we work with coefficients of variation, CV, of random variables rather than variances, since they are, unlike variances, dimensionless. Thus $\sigma^2 = \text{Var}(\tilde{Q})/\bar{Q}^2$ is typically the squared CV of output. Subscripts either refer to variables; σ_p is the CV of price, or derivatives: V_I is $\partial V/\partial I$, or indices (usually i, j, t) indicating the person, state, or date.

Ordinary derivatives are usually indicated by a dash: f', f'' , and partial derivatives by subscripted letters: f_x .

Key to frequently recurring symbols	
A	Coefficient of absolute risk aversion
e	Exponential
E	Expectation operator
R	Coefficient of relative risk aversion (of producer, R^p of consumer)
ϵ	Price elasticity of demand
θ	Risk, state of the world, random variable (usually supply risk)
Λ	Log normal variate
Π	Product notation
σ	Coefficient of variation, subscript refers to variable
Δ	Difference operator

Part I

Introduction and Summary

The book as a whole contains seven parts, each preceded by a short introduction. The first part of this book is, as its title suggests, intended to describe the structure and contents of the book, to guide the reader, and present a brief summary of the main findings in a non-technical language. Chapter 1 contains separate chapter guides for each of the three audiences who will be interested in our results – policy makers, economic theorists, and agricultural economists.

Since different people have very different ideas about the nature and objectives of commodity schemes, Chapter 2 discusses these various objectives, limits our study, and explains how it differs from earlier studies. Chapter 3 presents, in a fairly non-technical way, the major substantive conclusions of our study. Finally, Chapter 4 discusses the causes and consequences of price variability, and hence provides a framework for the subsequent analysis.

Chapter 1

Introduction

1.1 Background

This book is concerned with assessing the desirability of stabilizing agricultural commodity prices by means of a commodity buffer stock scheme. Agricultural commodities are extremely important to most of the less developed countries (LDCs) – in 1976 56 per cent of the non-oil exports of LDCs were primary products and roughly one-third of non-oil exports were produced in the agricultural sector. Moreover, these statistics understate the importance of commodity price instabilities as faced by particular countries: at least twenty-six LDCs depended on one commodity for at least 50 per cent of their export earnings during 1974–6 (excluding oil exporters) and a further eleven earned between 40 and 50 per cent from one commodity. At the same time, their prices have been – by any standard – extremely volatile. For instance, the decline in prices from the highest level attained in the period 1974 to August 1975 was 67 per cent for sugar, 58 per cent for sisal, more than 40 per cent for cotton and rubber, and more than 25 per cent for cocoa and jute.

For the thirty-seven LDCs heavily dependent on a single export commodity, the volatility in commodity prices may impose very large costs. As a basis of comparison, the largest post-war recession in the United States involved a reduction in national income from the preceding year of 8 per cent, and, if the 1946 downturn is excluded, only 2 per cent. The Great Depression involved a total reduction of national income of 29 per cent spread over a four-year period, with the largest annual decline of 15 per cent. But a farmer producing one of the crops mentioned above, if he had been able to avoid any other source of variation in his income and had stabilized his output, might have had a reduction in his gross income of between 25 and 67 per cent (depending on the difference between world and local producer prices), and a reduction in his net income of an even greater amount.

It is no wonder then that at least since the end of the First World War governments have been intensively concerned about the instability of primary prices. Periodic dramatic collapses in prices (such as occurred in the early 1920s and during the Great Depression) have typically precipitated discussions about international commodity schemes, and in the past fifty years there have been seventeen major agreements in nine commodities: sugar (4), coffee (3), cocoa (1), tea (1), rubber (2), copper (2), tin (1), bauxite (1), and wheat (2). (See McNicol, 1978.)

During the past few years, there has been increasing interest in the formation of a general commodity price stabilization programme, and it was this growing

interest that provided the immediate impetus for this book. Although we discuss in passing a number of alternative schemes that have been proposed, we are mainly concerned with price stabilization by means of buffer stock schemes. These put a certain amount of output into storage in years in which there is a large harvest, thus increasing price from what it would have been; and sell output from storage in years in which there is a small harvest, thus reducing price from what it would have been.

Although we are concerned with forming a judgement about the specific proposals which have been put forward – our general conclusion is that it is unlikely that such schemes would have a significant beneficial effect on the developing countries, and it is quite possible that they may even be made worse off – we are more concerned with developing a *methodology* with which this and other important policy questions in which risk plays a critical role can be assessed.

Several alternative approaches have been employed in the literature, involving the use of econometric techniques and simulation exercises. It is our belief that these approaches can be very useful, but only after one knows what it is that one wants to measure when one wishes to form an assessment of the costs and benefits of such a scheme, and only after one knows what parameters are likely to be important in determining the magnitudes of those costs and benefits. As we shall show, the standard specification (e.g. of linear demand and supply curves) strongly *biases* the results which emerge from the analysis even before the empirical study is undertaken.

The approach that we take is to formulate the simplest model which we believe captures the features of the economy most relevant for the question at hand. After formulating the model, we subject it to analysis in a number of different ways. In some cases we parameterize the various functions, and attempt to obtain an explicit solution, to see how the market equilibrium changes, for instance, when the degree of commodity price stabilization changes. When we do this, however, we then attempt to see how sensitive the results are to the particular parameterization employed, either by employing a quite different parameterization, or, more generally, simplifying the model still further in some dimension (e.g. by assuming that there are only two states, a good harvest and a bad harvest) which allows us to analyse the model keeping a fair degree of generality in other dimensions (e.g. general utility functions). In all cases we attempt to test the robustness of the model to slight changes in the assumptions. As in many other problems in economics, the total effect is a compound of a number of different effects, not all of which work in the same direction. Some of the effects we identify are probably not very important, others are. It is thus imperative, in any work of this kind, to obtain some order-of-magnitude feeling for the kinds of numbers involved, and this we do throughout the book.

It is important, however, to keep in mind the reason for these calculations: they are not intended to provide refined estimates of the costs or benefits of a commodity price stabilization scheme. Rather, they are intended to provide

some feeling for the relative importance of different factors and to provide some direction for future empirical research. That research should be directed to establishing more precise values for parameters which appear to be important on the basis of our rough estimates, hence the need to model and roughly quantify the different effects. Often our models will suggest particular econometric formulations which can be used in this research, or identify the way in which particular effects, such as risk, should be measured and included in the formulation.

1.2 The structure of the book

We had three different audiences in mind when we wrote the book — economic theorists, agricultural economists, and policy-makers — each with different interests and skills. In the next three sections we address each of these in turn in order to guide them through the book, identify the issues with which they will be most concerned, and mention the main contributions which the book makes. The final section of this chapter points to some of the more critical limitations of our analysis. Any respectable academic work must be accompanied by a list of caveats, in which the authors inform the reader that the authors are aware of the limitations of their analysis, and this is even more true when the book is directed towards policy-makers. The list provided in this chapter is not exhaustive, since we mention specific caveats at appropriate points in the body of the text.

The book as a whole is divided into seven parts, of which the first part is an extended introduction and summary. Since different people have very different ideas about the nature and objectives of commodity schemes, in Chapter 2 we discuss the different objectives and delimit our study. Even so delimited, our analysis of commodity price stabilization differs markedly from most of the earlier studies. It is important to understand the reason for this, and the remainder of the chapter is devoted to clarifying how and why our study differs from most of the earlier studies.

Chapter 3 presents, in a fairly non-technical way, the major substantive conclusions of our study. Finally, Chapter 4 discusses, in broad outline, the causes and consequences of price variability. The discussion is designed to provide a framework for the subsequent analysis.

Parts II and III present the fundamentals of market equilibrium in the presence of risk. Much of it can be viewed as an application of recent developments in the economics of risk to an analysis of agricultural markets, but several of the chapters present new developments. Part II presents the more basic supply and demand analysis, while the topics covered in Part III are somewhat more advanced, although no less essential for an understanding of the issues at hand.

Part IV is concerned with assessing the costs and benefits of price stabilization under the assumption that producers do not change their behaviour as a result of the price stabilization scheme, while Part V shows how these results have to be modified when producers can change their production decisions

(choice of technique, level of inputs, crop mix, etc.). Most of the book is thus concerned with the analysis of competitive market equilibrium on the assumption that prices adjust quickly to equilibrate supply and demand at full employment; and stays within the confines of microeconomics. Obviously, this is an important restriction which should be examined, and so Part VI addresses some of the macroeconomic issues raised by commodity price instability.

Finally, it is clear that any buffer stock scheme introduces a dynamic element into the market, for it is specifically concerned to transfer goods intertemporally. Fortunately, many of the problems we are concerned with can be discussed within a static framework, but some problems, particularly the design of a set of rules for the stabilization programme, can only be discussed in a dynamic framework, and Part VII is devoted to these.

1.3 Chapter guide for the policy economist

In a sense the remainder of Part I is an extended introduction, summary, and chapter guide for the policy economist. In addition, we suggest reading the introductions to each part and chapter together with the following sections. We recommend a quick reading of Chapters 5 and 6, which introduce the main concepts for our analysis of production or supply under risk. Section 6.6 derives the formulae for the producer benefits of stabilization. Chapter 7 discusses the theoretical and empirical evidence for attitudes to risk in a not too technical way. Chapter 12 presents a general survey of the responses available to agents confronted with risk, while Chapter 16 discusses the important and complex relationships between information, prices (especially prices on futures markets), and market equilibrium. The definition of price stabilization is set out and examined in the first part of Chapter 17, while Chapter 18 examines the importance of different econometric specifications of supply and demand.

The centre-piece of the analysis from the policy viewpoint is Chapter 20, which estimates the benefits of price stabilization. Finally, Chapter 29 gives a simple introduction to the dynamic analysis which is needed for the derivation of buffer stock rules. These rules are derived in Chapter 30, in which we suggest reading sections 30.1 and 30.4 onwards. The Epilogue draws out some of the conclusions.

We now suggest you turn to the last part of this chapter where we discuss some important caveats to bear in mind on what follows, and then to the remaining chapters in Part I, though the remaining sections of this chapter should also help clarify the structure of the book.

1.4 Introduction for the economic theorist

1.4.1 *Welfare analysis and the competitive paradigm*

Over the past few years, two, quite opposing approaches to the analysis of important applied economic problems have developed. One approach begins

with the presumption that the allocation of resources provided by the market is approximately competitive and hence Pareto efficient; the market should be interfered with only if a significant 'market failure' occurs, and then only with caution. In particular, redistributive policies should be designed to minimize any interference with otherwise competitive markets. Those who hold this view look askance at proposals involving systematic government intervention in the market of the kind envisaged by commodity price stabilization schemes.

The other approach believes that market failures are so extensive, and that the competitive equilibrium paradigm is so far from providing an adequate description of the workings of the economy, that to rely on it for policy guidance is mistaken. Although those who subscribe to this view are often hostile to theory, some theoretical support for the limited applicability of the perfectly competitive model is provided by recent results in the theory of the second best. This literature has been largely negative in spirit, suggesting how difficult it is to prescribe correct remedies when even a few of the critical conditions for optimality of the market equilibrium are not satisfied.

The view to which we subscribe is that the absence of the complete set of risk markets which are required for the optimality of market equilibrium is a sufficiently important market failure to cast serious doubt on the usefulness of the perfect market hypothesis for policy purposes, at least where the central policy concern is with the allocation of risk-bearing, as it is here. On the other hand, we believe that economic theory can shed considerable light on critical policy questions; we do not subscribe to the prevailing mood of atheoretical agnosticism.

1.4.2 *Contributions to the analysis of incomplete risk markets*

For the general economist, this book can be viewed as an exercise in the analysis – descriptive and normative – of an important class of second-best problems arising from the absence of a complete set of risk markets. There are several aspects of our analysis to which we would like to call attention.

(i) *Partial equilibrium analysis of price uncertainty.* Most of the economic analysis of uncertainty has focused on the implications of *income uncertainty*. Uncertainties about relative prices (including the relative price of consumption today versus consumption tomorrow, i.e. uncertainty about rates of return) are, however, extremely important and not very well understood. (See, especially Chapters 6 and 17.)

(ii) *General equilibrium analysis of uncertainty.* We develop in this book a simple general equilibrium analysis which has some interesting – perhaps surprising – results.

First, rational expectations equilibria are not in general Pareto efficient. This proposition, and the nature of the resulting biases are explicitly analysed in Chapter 15.

Second, free trade may be Pareto inferior to autarky, i.e. consumers and producers in each of two countries may be made worse off by opening trade

between them; equivalently, restricting speculative activity *may* constitute a Pareto improvement (Chapters 23 and 24).

Third, the impact and long-run equilibrium effects of policies which affect risk, and in particular, price stabilization schemes, may differ not only quantitatively, but also qualitatively (Chapter 22).

(iii) *Macroeconomic implications of price rigidities.* Most of the models of uncertainty that have been analysed to date have been equilibrium models in which prices and wages are flexible. We develop some simple macroeconomic models in which the implications of rigidities can be explicitly analysed. The model provides a qualitative analysis of a 'fixed price economy' which is subjected to a particular class of exogenous shocks.

(iv) *Dynamic analysis of buffer stock schemes.* The analysis of optimal buffer stock schemes (in one version of the problem) is equivalent to the problem of optimal savings with borrowing constraints. Although the problem of optimal savings under uncertainty has been extensively studied, limitations on borrowing have usually been ignored. These constraints have a significant effect on the nature of the optimal savings rule. We develop a general technique for obtaining approximations to the optimal buffer stock, as well as analysing certain important qualitative aspects of the optimal rules. (See Part VII.)

(v) *General equilibrium incidence analysis.* In the theory of taxation, the importance of tracing out the full consequences of how a tax on a factor in one sector is borne by the same factor in other sectors, has long been appreciated. In general, the tax does not just affect the factor on which it is nominally levied, but typically part of it is borne by other factors and part of it is borne by consumers. Under particular conditions, it is possible to obtain a precise analysis of the incidence of any tax (Harberger, 1964 and for a somewhat more general treatment, see Atkinson and Stiglitz, 1980). This kind of incidence analysis is potentially equally important for any government programme. We show how such an incidence analysis can be performed for commodity price stabilization: it turns out in fact that the partial equilibrium or impact analysis which ignores repercussions elsewhere is not only quantitatively wrong, but it may also be qualitatively incorrect in predicting the direction of response (Chapters 6, 22, and 24).

(vi) *Methodological contributions to the analysis of risk.* Finally, we hope our techniques of analysis will be found useful in a variety of situations. We should, in particular, mention the diagrammatic techniques of Chapter 22 for analysing the impact and general equilibrium effects of a change in risk, and our analysis of the effects of uncertainty on trade in Chapter 24. The two-state diagrammatic approach can also be used, as in Chapter 15, to illustrate the sources of inefficiency. The analysis of Chapters 17 and 18 shows how general properties of convexity can be applied to the study of price risk.

(vii) *Methodological contributions: cost-benefit analysis of risk-related public policies.* It is also our hope that the general procedures we develop here for cost-benefit analysis under uncertainty will be applicable to a wide variety

of situations where one of the explicit consequences of the policy is a change in the risk faced by various agents within the economy.

For instance, many decisions concerning the development of new energy technologies involve many of the kinds of considerations discussed in this work. These developments may alter in a significant way the probability distribution of prices which will prevail in the future, just as commodity price stabilization schemes alter the price distribution of agricultural commodities.

Even within agriculture there are a number of other problems for which risk analysis is central, e.g. the introduction of new seeds, and the application of fertilizers, pesticides, etc. We hope that readers will find some of our techniques of analysis useful in these other contexts.

1.5 Introduction for the agricultural economist

The economics of agriculture has long proved a fruitful source of insight into economics generally, with its concepts of rent and the margin of production. Markets for agricultural commodities lend themselves to the competitive story of homogenous products and individually unimportant agents each taking prices as given, while the pervasive government intervention in domestic agricultural markets provides many of the simplest examples of the distortionary effect of intervention in the competitive market.

Not surprisingly, agricultural economists were among the first economists to realize the importance of risk to an understanding of the functioning of the economy and to attempt to develop formal models for analysing its consequences. Heady (1952), for instance, devotes nearly a quarter of his classic text to the subject; and almost any recent issue of the *American Journal of Agricultural Economics* has at least one article related to the subject. Indeed, the absence of adequate insurance markets has provided a significant part of the rationale for government intervention, and particularly for government price stabilization programmes.

In spite of its importance, our understanding of the effect of risk on agricultural production remains limited. This is not surprising, for the concepts of risk and of risk aversion, although intuitive, are hard to define precisely. As a result, the literature has tended to employ special parameterizations. These parameterizations may, however, seriously bias the kinds of results obtained, and in any case limit the generality of the analysis.

In Chapter 6 we provide a precise definition of risk and risk aversion, which is both general and at the same time sufficiently concrete to enable us to obtain meaningful results concerning the effect of risk on agricultural production. It enables us to identify the special properties associated with the particular parameterizations which have been employed extensively in the literature.

The conventional treatment of risk is that it lowers the effective rate of return (by the 'risk premium') which would lead to lower work effort. But there is another argument which suggests that farmers work harder as a result of risk,

attempting to provide a margin for error. Our definition of risk and risk aversion shows that both cases are possible, and a second contribution of this book is to characterize situations where risk is likely to lead to higher levels of effort, and contrast them with the conventional response of lower effort. (See Chapter 6.)

The means by which individual farmers can respond to changes in risk are varied. One of the objectives of our analysis is to discuss these various responses, and to show how the availability of these various methods for *sharing*, *reducing*, and *shifting* risk implies that the effect of a change in risk on the level of output of a particular crop may be markedly different from that which would have occurred had the farmer been limited, say, simply to varying the level of input, the choice of technique of production, or the choice of crops. Chapter 12 provides a general survey of these issues, and Chapters 13 and 14 specific examples.

Although the focus of our analysis is theoretical, our results have important implications for the estimation of agricultural supply functions. Not only do we argue that risk needs to be taken into account, but our analysis suggests that certain commonly employed specifications may be theoretically suspect. This applies both to the estimation of attitudes to risk (Chapter 7) and to the specification of risk itself, and of demand (Chapter 18).

Although much of agricultural economics has been concerned to develop our understanding of the behaviour of the individual farmer, recent discussions of commodity price stabilization serve to remind us that markets for most primary commodities are international. What happens in one country affects prices in another. In particular, although it has long been recognized that the market price is determined by the interaction of demand and supply, i.e. the demand from all countries and the supply from all producers, the fact that the price *distribution* is determined by the interaction of the *distribution* of the demand and supply functions does not seem so widely recognized. Thus, the magnitude and nature of the risk faced by any individual producer is, in part, a result of the variability in supply of some other group of producers. These interactions are complex — far more complex than the simple interaction of non-stochastic demand and supply curves; but any analysis of the effects of a major policy change such as the stabilization of prices requires that they be taken into account. We discuss their effect on producers in Chapters 5 and 6, on consumers in Chapter 9, and on the market in Chapters 10 and 11. In Chapter 19 we show how these impacts are modified by distortions, and in Chapter 23 we examine the interaction of different sources of risk through international trade.

One reason for the complexity of the interactions is that there are many important intertemporal aspects to the analysis: farmers' actions depend critically on their expectations concerning prices which are likely to prevail in the future. But those expectations are likely to have been influenced by prices which occurred in previous periods, which in turn depended in part on the earlier actions based on earlier beliefs about prices, and so on. It is therefore important to enquire how farmers form their expectations, how they learn that

their estimation procedures are misleading, and how they modify their forecasts. Given the importance of expectations, we develop as a bench-mark the theory of rational expectations in Chapter 10, which has the characteristic that, given what the farmer can observe, no further learning can take place, and he would not wish to modify his method of forecasting or decision-making. We compare this bench-mark with alternative methods of forecasting in Chapter 11, where a stochastic version of a cobweb model is analysed. We show that the stability of the model depends explicitly not only on the shape of the demand and supply curves (as earlier discussions have pointed out) but also on the speed of learning (adaptation). Slow speeds of adaptation lead to stability, but the economy may be far from the rational expectations equilibrium most of the time; faster speeds of learning mean that the economy may be more efficient, if it converges to an equilibrium, but it is less likely to converge. Then, in Chapter 16, we discuss other sources of information, especially futures markets, which may assist the farmer in his decision-making.

Finally, although public policy towards agriculture has long been a subject of academic interest, the discussions have, for the most part, employed old Marshallian surplus analysis which we argue is particularly unsatisfactory in the presence of risk. Moreover, many of the earlier studies have used special parameterizations which prejudice the distributional issues, as we show in Chapter 18.

We set out the main differences between our approach and the conventional analysis in Chapter 2, which also directs the reader to the places in the book where specific issues are taken up. In brief, our analysis is characterized by (a) an attempt to ascertain the incidence of any policy measure both in the short run and in the long run; and (b) an attempt to identify precisely the source of market failure which might necessitate government intervention in the market and the implications that this market failure has for the benefits and costs of the public programme. It is the absence of perfect risk and futures markets which, in our judgement, makes commodity stabilization schemes so potentially attractive, and it is, therefore, the effect of price stabilization on risk-bearing and risk-taking which provides the focus of our analysis.

1.6 Caveats and limitations

Any study with policy implications, such as this, needs to be hedged about with caveats and the overriding cautionary remark that the policy implications only follow if the models from which they derive are adequate descriptions of reality. Ours is no exception, but the caveats carry even greater force, for our aim is primarily methodological and theoretical. Ultimately, judgements concerning the desirability of any commodity price stabilization will depend on certain empirical magnitudes, and a theoretical study cannot, therefore, provide the final answer. But a theoretical study of the kind we have undertaken here can point the way to what numbers to look at; and it can distinguish between

'bad' arguments and 'good' arguments for commodity price stabilization. In some cases, order-of-magnitude estimates of the variables which the theoretical study suggests are critical can be obtained, and these order-of-magnitude estimates can be used to make an informed judgement on whether, with more refined techniques, it would appear that a commodity price stabilization would substantially increase or decrease welfare, or whether the welfare changes – positive or negative – are likely to be small. The empirical results reported in Chapter 20 are presented in that spirit: not as definitive calculations but as order-of-magnitude calculations which, in themselves, seem to us very enlightening.

The second point to stress is that, as in any theoretical study, there is a delicate balance between the generality, detail, and complexity of the model on the one hand, and its tractability on the other. We have opted for a model which is more complex than is generally found in simple policy studies, yet of less generality than is found in traditional general equilibrium analysis. We have attempted to formulate the simplest model which can, at the same time, capture what we consider to be the essential features of the markets being examined. Clearly, there is considerable scope for further development of the models presented here, and one of our aims is to provide the stimulus for further model building, particularly of macroeconomic models of the kind discussed in Part VI.

Third, we need to emphasize that the relative allocation of space devoted to various topics within this book is not only a reflection of our judgement concerning the importance of the topics. Three other considerations played a part: first, we devote more space to those topics on which we have something new to say than to those which have been discussed extensively elsewhere. Second, we devote more space to those topics which are more difficult: there are many important points which can be made simply, and we hope we have done that. Third, there are some topics which we think are probably extremely important but on which we are quite brief, especially macroeconomic and dynamic issues discussed in Parts VI and VII. We would have liked to have been able to say more about these, but at the moment our knowledge in these areas is still relatively undeveloped. We hope that our remarks will at least serve to stimulate further research.

Finally, and more as an apology, we should point out that the literature in this area has been growing rapidly, and although we have attempted to note those studies published before the first draft of this book was completed (December 1977), we have not attempted to reference much of the subsequent literature. We have, however, identified a few surveys and collections of articles which will guide the interested reader through the literature.

Chapter 2

The Main Issues

2.1 Background to the problem

Undoubtedly inspired by the success of the OPEC cartel in raising the price of oil, during the past few years producers of other primary products have brought increasing pressure for the creation of some scheme which would stabilize (it was hoped at a high level) the prices of the commodities which they sell. At the time this book went to press, these pressures had not yet been successful in establishing a commodity price stabilization scheme but resolutions calling for the establishment of an Integrated Programme for Commodities (IPC), covering the ten core commodities identified by UNCTAD as suitable for stockpiling, listed in Table 2.1, were passed in a special meeting of UNCTAD held in Nairobi in May, 1976.

Table 2.1, which is extracted from one of the key supporting documents presented to the conference, demonstrates (in, as we shall argue in Chapter 20, a rather exaggerated way) the magnitude of price instability facing producers of primary commodities. However, even if we take yearly deviations from trend (as opposed to monthly deviations) as an indicator of price variability, Fig. 2.1 demonstrates that the fluctuations for six selected agricultural products have been substantial, by any standard.

However, it is important to remember that the Integrated Programme was always intended to be more than a stabilization scheme. Although buffer stocks were recommended for all core commodities, in all but two cases – cotton and tea – these buffer stocks were to be coupled with supply management measures (UNCTAD, 1975a), typically involving the permanent use of export quotas and/or production controls. In this respect the IPC follows tradition, for most commodity schemes have attempted to control supply.

The debate on the desirability of commodity price stabilization has been confused by the variety of different objectives which such schemes might pursue. In this book we are only concerned with pure price stabilization schemes in which there is no attempt to restrict production or trade. In this chapter we first look at the various objectives which have been proposed for commodity programmes in order to contrast them with pure price stabilization schemes, and then list the ways in which our approach differs from and advances upon the traditional analysis.

2.2 Objectives of commodity price stabilization schemes

The broad objective of all commodity programmes is to improve the welfare of primary commodity producers, or, more generally, the producing countries. The

Table 2.1 Recent declines in commodity prices for 'core' commodities

Commodity	Highest price in period 1974-5		Prices in August 1975 (cents per lb)	Decline from peak %	Instability index ^a %
	Level (cents per lb)	Month reached			
Sugar	56.6	Nov. 1974	18.7	-66.9	109.1
Coffee	88.5	Aug. 1975	88.5	—	22.9
Cocoa	117.2	May 1974	78.3	-33.2	45.9
Tea	71.1	Mar. 1974	60.9	-14.3	14.7
Cotton	103.8	Jan. 1974	59.6	-42.5	28.3
Jute	20.8	Oct. 1974	15.0	-27.8	21.0
Sisal	48.5	June 1974	20.0	-58.7	62.4
Rubber	49.2	Jan. 1974	27.2	-44.7	32.2
Copper	137.5	April 1974	58.0	-57.8	41.9
Tin	415.3	Sept. 1974	306.0	-26.3	42.2

^a Coefficient of variation of prices over period 1950-74.
Source: UNCTAD (1975a): TD/B/C.1/195.

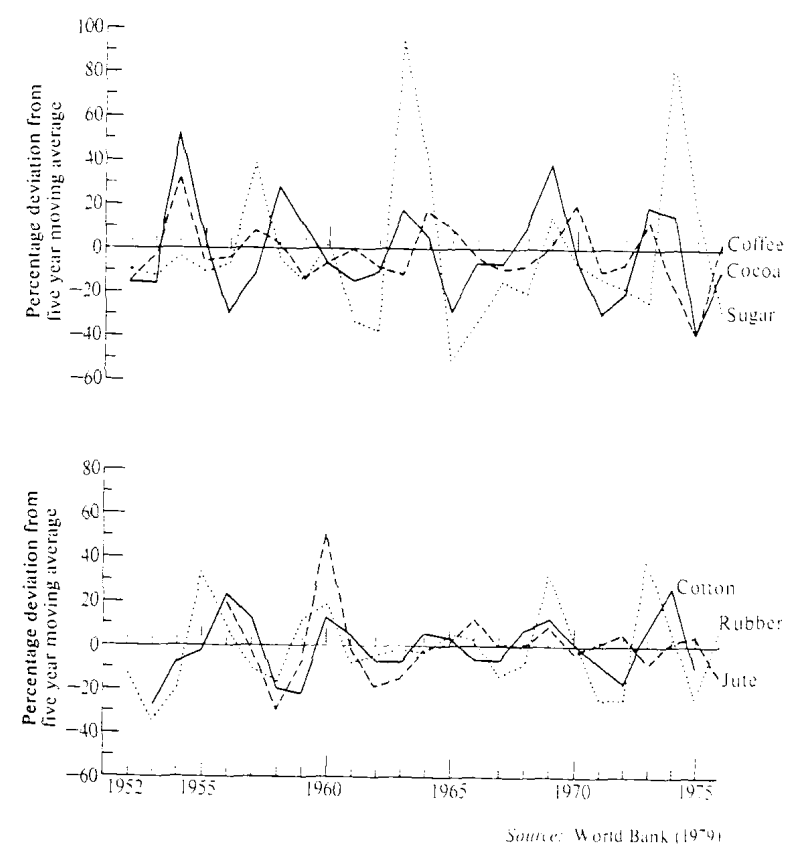


Fig. 2.1 Deviations of six 'core' commodity prices from trend 1952-75

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IPC is directed to improving the welfare of LDCs in particular, though it is worth remembering that the developed countries export more primary commodities (excluding oil) than LDCs. Within this broad framework, several distinct objectives can be distinguished.

2.2.1 *Raising average prices and incomes*

One of the main objectives has been to raise the average price of primary commodities. Although it is now generally accepted that the terms of trade between primary commodities and manufactured goods has shown no long-run tendency to decline, there is a widespread belief that the prices of primary commodities, especially agricultural goods, are unjustly low because of the long-standing structure of protection by the importing countries. Not only do these tariffs depress the world price below the free trade level, but quotas and domestic support programmes also restrict the rate of growth of demand for many agricultural commodities. Faced with this market structure, exporting countries have two possible responses – to attempt a negotiated reduction of trade restrictions and/or to attempt to set up a countervailing cartel. Since these are quite distinct objectives, we consider the cartel approach first. The success of OPEC has encouraged other primary producers in the belief that co-operative action which restricted supply would improve their income and welfare. The problem is, of course, how to devise an acceptable agreement limiting output, since it will typically be in the interests of the smaller countries to expand production while benefiting from the raised prices. The other problem is that many LDCs also import primary commodities and would be adversely affected by such cartel action, while the developed countries would either benefit from the raised prices, or, if they opposed it, would undermine the cartel.

While there may be a case for such programmes (perhaps employing a uniform export tax on specific commodities, with the revenue allocated for development) our analysis is confined to pure price stabilization schemes in which there is no restriction on output or trade. As a result we avoid the problem of devising an acceptable agreement on supply restrictions. Nevertheless, we shall argue that even a pure price stabilization scheme will typically affect the level and pattern of supply and may also have significant distributional effects on producers and consumers. Indeed, much of our analysis will be concerned precisely with these distributional effects, which appear to be of the same order of importance as the net (efficiency) benefits of price stabilization.

2.2.2 *Market access and tariff reform*

As remarked above, protective policies against agricultural imports are of long standing, and particularly difficult to dismantle because of their intimate connection with domestic price policies and farm support programmes. Obviously, their removal should improve the revenues of the exporting countries, and in many cases would also improve the welfare of the importers if they could devise a satisfactory compensatory scheme for domestic producers.

Quite apart from their general desirability, such reforms bear on the issue of commodity price stabilization because it has been argued that the trade restrictions are in large part responsible for price instability. The logical approach to price stabilization is therefore to reduce the trade barriers which tend to fragment the world market. Market fragmentation means that small variations in supply can lead to wide fluctuations in the world price. Thus between 1972 and 1974 the US wholesale grain price more than tripled, while in the EEC it rose by 20 per cent, and in the USSR remained almost unchanged. Had the world market been unified (with the same market clearing spot price everywhere) the modest production shortfall need only have induced a small price rise.

Although we agree that tariff reform is the single most attractive approach to the problems facing the LDCs, it is quite distinct from the problem we discuss, which is to assess the impact of buffer stock schemes on the existing market structure. Nevertheless, the fact that trade in many primary commodities is distorted by protective policies raises some important issues for our approach which we discuss in Chapter 19.

2.2.3 *Reducing the risks faced by producers*

We are primarily concerned with the consequences of changing the variability in prices. One of our main arguments is that producers are concerned not so much with price variability as with income variability. There has been considerable confusion between the two alternative objectives of stabilizing prices and stabilizing income. Stabilizing prices might, as we shall see below, lead to increased income variability. This distinction is particularly important if farmers grow several crops whose returns, though individually unstable, are collectively relatively stable. A price stabilization programme for just one commodity might then induce large supply responses and have an adverse effect on prices and returns without reducing income risk.

Indeed, in Chapter 14 we go one step further, for it is not variability in income but in consumption that is ultimately important. We need to ask whether it is more efficient to have a buffer stock for *commodities* (or, at the margin, to subsidize such a buffer stock), to smooth prices, or to develop better methods of 'storing' *income* (or, at the margin, to subsidize the establishment of credit institutions) to smooth consumption directly. These distinctions between price, income, and consumption variability play an important role in our analysis.

2.2.4 *Macro-stabilization and development*

The consequences of price and income variability facing producers spill over to other sectors of the economy. In particular, they may lead to macroeconomic instability – unemployment and inflation – which we explore in Part VI. In addition, there is some concern that the variations in foreign exchange earnings resulting from price variability may have a deleterious effect on the development of LDCs (although the contrary argument, that variability in prices has no adverse effect on the level of investment, has also been put forward). In those