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JOINT ECWA/FAO AGRICULTURE DIVISION

A STUDY OF ADJUSTMENT OF OUTPUT TO PRICE IN THE AGRICULTURAL SECTOR

by

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Preliminary Study

This preliminary study was prepared by the author while serving as a short-term consultant to the Joint Agriculture Division.

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I. INTRODUCTION

A. General Introduction

Economic policy recommendations are almost always based on the expected response of the economic agents concerned, to the specific measures of such policy. Even in cases where the entire production process is dictational, the ultimate consumers' responses are relevant for making such recommendations.

The success of a set of policy recommendations depends, in part, on whether the assumptions regarding the responses underlying the recommendations turn out to be valid. Many policies are based on a priori assumptions regarding these responses; for example, if the price of a product is raised, the suppliers will try to supply more; or if the price of an input is raised, input users will attempt to use less of it, and so on. In most cases, the qualifications to such bald positions which economic theory itself makes, or which are suggested by the institutional and other factors, are simply ignored; in most of the others, they are mentioned in passing and then forgotten.

Ignoring the possibility that the economic agents may not act in a priori expected way, as predicted by simple economic theory, may probably be justified if the stakes are not high and the policies recommended are qualitative rather than quantitative. However, if one is dealing with matters which are of considerable significance, and the policies to be recommended are quantitative, one cannot afford to accept these a priori and traditional assumptions. In such cases one would try to find, rather than simply assume, what the responses are likely to be. The usual way of predicting these responses is to project them from the past experience. This is also the approach we adopt in this study.

In deciding to study the agricultural sector of some ECWA countries for ascertaining the nature of these responses we have, of course, implicitly assumed that the agricultural sector of these

countries is important enough to warrant this attention, and/or that the policy makers are interested in the quantitative as well the qualitative aspect of their policies. In our view both these assumptions are valid, and in view of this we examine in this study one specific response, which we call "output adjustment". It is the response of the producers of the agriculturalist, in some ECWA countries, to changes in the prices of their major products.

B. The Objectives

The objective of this study, as would be partly clear from the above, is to find out how the farmers of Syria, Iraq, Jordan and Saudi Arabia, four of the ECWA countries, have adjusted to the changes in the price of their output.

More specifically the information we seek is whether these farmers have tried to supply more of a commodity whose price has gone up. After having done this, we go on to study the implication of the answer to the above question for policy purposes.

It should be pointed out that the answers will help us in formulating policies, irrespective of what these answers happen to be. From the point of view of making policies, a refutation of some *a priori* held positions in economics is as useful as their confirmation. One may even go further and say that a refutation would make the study even more important and worthwhile, since most policy recommendations, in the absence of such a study, would assume that *a priori* accepted situation exists, and hence would be based on wrong, premises. On the other hand, the policy made in the above manner would be right even in the absence of a proper study, if this would in any case have only supported the prior held position.

C. Plan of the Study

The study contains six chapters - Chapter I (the present one) is introductory. Each of the subsequent four chapters deals with one country: Chapter II with Syria, Chapter III with Iraq, Chapter IV with Jordan and Chapter V with Saudi Arabia, Chapter VI, the final chapter, presents a brief summary of the results and the conclusions and recommendations which may be derived from them.

Each of the substantive chapter (Chapter II to V) is, in turn, divided into three sections. The first presents a "broad" or long term view of the variables prices, quantities, etc., and their possible relations, which we call "long run adjustment" and the second presents regressions which analyse "short-run adjustment" (these are explained in Section F below). The last section of each chapter briefly summarises the results of the previous two sections.

D. The Choice of Variables and its Significance

The question of adjustment of output is usually expressed in terms of the farmer's attempt to produce more of a product when its price goes up.

At first glance the hypothesises may appear simple and unambiguous. But only a second glance is sufficient to convince one that it is neither. What exactly do we mean by an "attempt to produce..." and how do we measure it. And when we say "its price goes up", do we mean its absolute (money) price or its price in terms of some other commodity (ies), that is, its "relative" price. It is expositivally convenient to discuss the question of price first.

Let us first look at the meaning of "absolute price" more closely. It is the amount of money one pays for, let us say, a ton of wheat. This is straightforward, once we know what money we are using. The question of relative price is more complicated. What criteria should be used in the choice of one or some relative prices out

of a large number of possible relative prices which we can define? Even prior to this is the question: why bother with relative prices at all?

A simple example may clarify. Let us say that there are only two crops, tomatoes and wheat, and both their prices go up; the former by 5 per cent and the latter by 10 per cent. According to the absolute price approach, the adjustment hypothesis will require that farmers try to supply more of both. It is quite possible, however, that certain inputs, such as farmer's own time, or the land he cultivates, is fixed, or almost fixed, in supply; hence it may not be possible to increase both the products simultaneously, and in fact it could be quite possible and proper that in order to increase one, he reduces the supply of the other. If he did this, he would be going against the dictates of the absolute price approach. On the other hand, a relative price approach would require him only to supply a proportionately larger quantity of wheat because the relative price of wheat has gone up, and the above situation would be quite in conformity with the relative price approach. Such approaches can also take care of the situation when the price of a commodity has gone up, but the farmer's cost of living has gone up even further. An absolute price approach would still require him to attempt to supply more of his product in spite of the fact that the "effective price" (the price in terms of purchasing power) he receives has gone down. The relative price approach would not require him to do this, as the relative supply of one of the two products may still go up, even if the absolute supplies of both of these have declined.

I think that the above explains the purpose of including the relative price approach, and also indicates the type of commodity relative to which the price and quantities etc., of another commodity should be expressed. The most suitable choice is that of another commodity produced by the farmer(s). In the above example, if the quantity of wheat/quantity of tomatoes is related to the price of wheat/price of tomatoes, we have the relative price approach, while

we have the absolute price approach where the quantity of wheat is separately related to the price of wheat and the quantity of tomatoes with the price of tomatoes.

The above discussion also makes clear what we mean by the "effort to supply more" in different contexts. If the response is to the changes in absolute prices then the index of efforts to supply will have absolute magnitudes (for instance, the quantities of output, more on which later), while if the response is to changes in the relative prices then the index of efforts to supply will have relative magnitudes, (e.g., the rates of these qualities).

There is a further questions, however: What should be considered an appropriate indicator of "attempting to supply more", when the actual quantities supplied may be affected by factors occuring after the decision has been taken, and which is completely outside the control of the supplier? An obvious and most important example is such factors as natural causes. Thus if a farmer tries to supply more of a product, but the rainfall is unfavourable, he may not succeed in supplying more of that product. The inclusion of rainfall in the regressions partly meets this difficulty. However, one could instead use another indicator of efforts to supply more which does not directly depend or such causes e.g. an increase in the land area used for that crop. Even when the rainfall can be included in the analysis, as in our regression approach, one may argue that the decision to use more or less land for a particular crop is a clearer indication of the decision to supply more or less of that crop than the actual amount of the crop produced, even when modified by the inclusion of the rainfall, because the total annual quantity of rainfall cannot represent all the natural causes.

These and other considerations and questions may be raised in deciding which variables to choose for testing the adjustment hypothesis. Each choice has some implicit or explicit theoretical assumption(s) associated with it. To take the simplest case, if the relevant price changes are supposed to be in absolute (money) terms, then one of

the implicit assumption behind this choice may be that the farmers, in general, have the classic case of "money illusion". But as the assumption of money illusion, on the part of economic agents, has quite a respectable tradition in economic analysis, excluding it completely from the analysis may be considered unjustified. For this reason we have decided to analyse the relationships between relative prices and corresponding relative quantities as well as between absolute prices and corresponding absolute quantities. For similar reasons, we have analysed the changes in the quantities produced, as well as in the land under cultivation, in response to changes in prices.

The purpose is to address the problem in as many reasonable ways as can be done within the limits of a paper-length study, such as this. However, it should be made clear at this stage that the results based on relationship between absolute magnitudes, in this study, have much weaker foundation than those based on relative magnitudes.

For this study we have chosen four most important crops from each of the following countries: Syria, Iraq and Jordan, and three major crops from Saudi Arabia.[1/] For Syria, they are (i) wheat, (ii) barley, (iii) sesame seeds and (iv) tomatoes; for Iraq, they are (i) wheat, (ii) barley, (iii) rice and (iv) tomatoes and for Jordan they are (i) wheat, (ii) barley, (iii) tomatoes and (iv) grapes and finally, for Saudi Arabia, they are (i) wheat, (ii) tomatoes and (iii) barley. For each country the crops are given in order of their importance, measured by the value of the outputs produced.

These generate the following relative terms:

For Syria: (i) wheat/barley, (ii) wheat/sesame, (iii) wheat/tomatoes (iv) barley/sesame, (v) barley/tomatoes and (vi) sesame/tomatoes.

1/ The fourth (grapes) does not have long enough series for our purposes, and there is no other major crop in Saudi Arabia.

For Iraq: (i) wheat/barley, (ii) wheat/rice, (iii) wheat/tomatoes, (iv) barley/rice, (v) barley/tomatoes, (vi) rice/tomatoes.

For Jordan: (i) wheat/barley, (ii) wheat/tomatoes, (iii) wheat/grapes, (iv) barley/tomatoes, (vi) barley/grapes and (vi) tomatoes/grapes.

And for Saudi Arabia: (i) wheat/tomatoes, (ii) wheat/barley and (iii) tomatoes/barley.

The relationship between prices, quantities and acreage of these items (expressed either in relative or absolute terms),[2/] modified by the possible influence of the rainfall, is studied in the chapters which follow.

E. The Data

The data used and their sources are indicated in the statistical appendices at the end of this study. Due to the non-availability of sufficiently long series for farm prices (and also due to its unreliability) we have taken import prices as an index of the prices received by the farmers. This is another reason, among many others, why the results and conclusions of this study should not be treated as much more than some first tentative findings. The reason we have confined our study to four countries is that suitable data are available only for these, and in fact, even among these countries, we do not have complete data for Saudi Arabia, and to some extent, for Jordan either.

Leaving aside the incompleteness and unavailability of the data, their quality is also not of the highest order. Hence the results obtained from them should be used with even greater caution than may be inferred from the above qualifications. In the meantime, efforts

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2/ It is, of course, true that the possibility of relative adjustment varies among the crops. These details have been ignored in this, rather brief, study.

should continue to improve the quality of the data, and the analysis should be repeated when they become available.

F. Method of Study

The general hypothesis of output adjustment, which we examine in this study, has already been stated: Farmers adjust to a rise in price of a product by trying to increase the supply of that product. We have also seen that the hypothesis can be stated in absolute as well as in relative terms. The next question, which will be quite familiar to the students of Economics is whether this adjustment is made only in the long run or it is made also in the short run. Thus we have a long run adjustment hypothesis and a short run adjustment hypothesis.

We treat the data, in the text of the study, in two different ways, depending on whether we are examining the long run or the short run hypothesis. For the long run hypothesis we use the simple trend approach and try to find whether the trend of prices and the corresponding quantities or acreage of output have the same direction. For the short run analysis we use the multiple regression approach. This has not been done, however, in the belief that one cannot test the long run hypothesis through regression analysis. For instance, one way of testing the long run hypothesis can be through using some form of "adaptive expectation approach" (following Nerlove) in which the price experience over a long period is allowed to influence the decision regarding the output of a particular period. In fact we have presented some results from this approach in the Appendix (after Chapter VI) entitled "Adaptive Expectation Approach". We, however, find there that our conclusions do not alter even if we take the results of this approach as the basis of our conclusions. Moreover, the "long run", in this sense, does not quite capture the broad sweep of the simple approach we have adopted in the text; nor is it so easily understandable to the general reader. Hence we have retained, in the main text, the simple trend approach for examining the long

run adjustment hypothesis, in spite of its being less sophisticated and open to more serious technical objections than the regression approach provided in the Appendix to the study.

As mentioned above the broad or long run approach uses trends or rates of growth as tools of analysis. However, for obtaining a meaningful 'trend' from a series of observations, it is essential that there should not be a qualitative break in the nature of the series; otherwise we shall not have one series but several containing many trends, not related to each other. We could of course still calculate a trend for all the observations, but it would be little more than a meaningless number. This consideration posed a problem for us in this study, since there undoubtedly was an abrupt and sudden change in the economics of this area in 1973, and the agricultural sector was not immune from this.3/ For this reason the period we have chosen for trend analysis ends at 1972. It would have certainly been preferable, from the policy point of view, to take up the most recent available period for analysis, but the data available for the post-1973 period cover only 1974-77, which is too short a series for using this approach. The trend analysis has thus been applied to the data of period 1960-72, except where information is not available even for parts of this period and the period of analysis has been shortened accordingly.

In choosing the period for regression analysis we had to face a simpler practical problem. Usable data for rainfall was not available for period prior to 1966. Hence, the period chosen (except, again, where particular data are not available) is 1966-77. The regression results are also vitiated by the events of 1973, but as in this we are concerned with the year to year happenings rather than

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3/ See for example the dramatic changes in agricultural export and imports reported in An Analysis of Some Salient Features of Arab Trade in Agricultural Commodities During the 1973-75 Period. United Nations Economic Commission for Western Asia E/ECWA/AGRI/79/4, May 1979.

with the trend over a long period, the effect is not likely to be as damaging. In any case, 1966-72 would be too short a period for analysis.4/

It may also be helpful, at this stage, to note how the differences in the nature of the two approaches may affect the relative significance of the results, obtained by using different types of variables noted in the previous section.

In the broad or long term view, one would expect firstly that the economic agents have less money illusion than in the short period view, as they have now more time to see behind the façade of money. Hence, the results from the relative rather than absolute magnitude would be more reliable. Secondly, one would expect that the fluctuations in the output due to seasonal and weather factors are likely to be ironed out over the long period. Hence, the problem of the quantity of output as an index of the "attempt to supply more" will not be open to kind of criticism which may apply to the short term analysis.

In the short period analysis the assumption of "money illusion" can be more easily justified. Again, in the short period the vagaries of nature may have greater influence on output, hence one may consider increase in land under the crop to be as good an index of the "attempt to supply more", as the increase in the quantity of output, even when the influence of rainfall is incorporated in the analysis; as there are other factors besides the total yearly rainfall which form part of the vagaries of nature.

It would thus appear that the analysis is in terms of relative magnitudes and in terms of output rather than of land as an index of the "effort to supply", is somewhat more suitable in testing the long view adjustment hypothesis, while no such preference to one or other types of variable can be given when testing the short run adjustment hypothesis.

4/ One could, of course, use dummy variable to take care of this, but this would make the analysis even more complicated for the general reader, and has not been attempted.

Finally, as the crops take time to mature after a decision to produce has been taken, we have assumed a year's lag between the price and the quantity produced in response to it. As there need be no similar lag between the price and the acreage, no lag has been assumed between them.

APPENDIX: Key to the Evaluation of Regression Results

A considerable part of the study, which follows, consists of the analysis of the results obtained from the regression approach. We realize that most of the readers of this study will not be professional econometricians and may not even be academic economists, and it is quite likely that they may not be fully familiar with, or would have become somewhat rusty on, the econometric terms which had to be used in the analysis, in spite of our attempt to keep the analysis at the simplest possible level. For this reason we have added this Appendix which provides a sort of glossary of such terms.

There are only four terms which have been most frequently used in evaluating the results of the regression analysis. They are: (i) R^2, (ii) sign of the co-efficient, (iii) 't' statistic and (iv) Durbin-Watson or D-W statistic. We explain them as briefly as possible, even at the risk of omitting important qualifications.

1. Let us first take the R^2. If we want to find out, for instance, the extent to which the variations in the quantity of wheat produced in Syria can be explained by the variations in the lagged price of wheat and rainfall we can look up the R^2 for wheat in Table 2. We find that the $R^2 = 0.43$. This means that only 43 per cent of the changes in the quantity of wheat can be explained by changes in its price and the rainfall, taken together. The remaining 57 per cent will have to be explained by factors not taken into account in the analysis. Thus the higher is the R^2, the greater is the support to the hypothesis that output adjusts to prices when account is taken of the fact that rainfall also affects output. The maximum possible value of R^2 (never attained in practice), is, of course, 1.0, which would imply that all the variations in output can be explained by the variables cited.

However, there are some very serious and important conditions which have to be fulfilled before one can use the value of the R^2 in

support of a hypothesis. The three other factors we have mentioned above viz. the sign of the coefficient, the 't' statistic, and the D-W are considered to be the most important ones among these conditions.

2. The sign of the coefficients: A given R^2 will not support the adjustment hypothesis, (higher price leads to attempt at larger output) if the sign of the coefficient of price (the second column in Table 2 for instance) is negative. In fact, taken by itself, this will support the opposite hypothesis. Hence, for the result to support the adjustment hypothesis, the sign of the price coefficient must be positive.

3. The 't' statistic: While the R^2 tells us the extent to which prices and rainfall, taken together, explain output variations (say), the 't' statistic for price (for instance), which is given in brackets under the price coefficient, tells the extent to which the price variable is significant in explaining those variations. Thus even with high R^2 we cannot say that price changes are significant factor in explaining changes in output unless we have also a high 't' statistic for the coefficient of price. As a crude measure, a statistic of less than 2 reduces the significance of the coefficient to an unacceptable level.

4. Durbin-Watson or D-W: Sometimes a high R^2 (and the 'ts') may not represent the actual relationship between the variables, and may result from the fact that the errors in the variables are related to their own respective past values. In that case the R^2 (and 'ts') will represent spurious relationships. The relationship of the errors in the variables with their own respective past, called "autocorrelation" has to be fairly weak for the R^2s and 't' to be meaningful. D-W is a measure of this autocorrelation. As a crude measure, a D-W very much less than 2 shows that the positive autocorrelation in unacceptably high, while one which is very much higher than 2 shows that the negative autocorrelation is unacceptably high. However, following the usual convention, we shall be mainly concerned with positive autocorrelations.

II. OUTPUT ADJUSTMENT ANALYSIS FOR SYRIA

A. The Broad View

The broad view, as noted in Chapter I, presents the trends by the rates of growth of the relevant variables. Table 1 below presents these rates of growth for the four most important commodities in Syrian agriculture.

Columns 1 to 4 in the table represent the trends of absolute magnitudes, while columns 5 to 10 present those of the relative magnitudes. Let us examine them separately.

We find that the absolute quantities and prices move in the same direction in only two out of four cases, while prices and acreage move in the same direction in three out of four cases. It is clear that for neither of the two cases is there any overwhelming support for adjustment in response to absolute prices, even though it is somewhat more favourable in the case of acreage than of the quantities supplied.

Turning to the relative magnitudes (columns 5-10), we find that the relative prices and the relative outputs move together in five out of six cases, while the prices and acreage move together in four out of six cases. Taken together one can suggest that the results of relative magnitudes are slightly "better" than those of absolute magnitudes, and furthermore the results using output as variables give somewhat "better" results than those using acreages. Hence one may say that at least in these respects the result conforms to the expectation regarding the long run trend indicated in F. of Chapter I. However, the main point is that the support to the long adjustment hypothesis, even if we accept the above argument, is far from being overwhelming. At best, one can say that the trend analysis for Syria provides a mild support to

this hypothesis, as there are more cases where relative prices and relative outputs have moved together than those (in fact only one) where they have moved in the opposite direction.

Table 1. Trend Analysis for Syria 1960-72*

(Percentage Exponential Rate of Growth)

	1	2	3	4	5	6	7	8	9	10
	Wheat = W	Barley = B	Sesame = S	Toma-toes = T	W/B	W/S	W/T	B/S	B/T	S/T
Quantity or quantity ratios	0.2	-5.9	2.1	9.6	4.9	-1.2	-8.3	-6.7	-16.9	-11.6
Price or price ratios	-0.3	2.1	3.3	6.0	-2.9	-3.5	-9.9	-0.8	-4.6	-1.9
Acreage or acreage ratios	-1.6	-1.8	6.6	1.9	0.6	-8.3	-0.7	-9.0	-1.9	7.5

Source: See Appendix Tables 1 to 4.

*Due to the paucity of data the period for barley is 1961-72 and for tomatoes 1964-72. Among the ratios, the period common to both the numerator and denominator is taken. For instance for barley/tomatoes (B/T) it is 1964-72.

B. The Regression Analysis for Syria

Table 2 presents the regressive results for absolute magnitudes. It will be noted that a one year lag has been assumed between price and output (as will be done throughout this study), but none between price and acreage. The reason for this was explained in section F. of Chapter I.

Let us take the quantity results first. The R^2s are not high, even in the first three cases; and for tomatoes, it is too

low for claiming any relationship. The signs of the coefficients are as expected. The signs for the price coefficient are positive and thus conform to the adjustment hypothesis, and the coefficient of rainfall is positive suggesting that a higher rainfall is associated with higher output. The 't' statistic shows that for the first three items the price coefficients are also significant and the Durbin-Watson statistic except for the last item, indicates the absence of any serious auto-correlation. Thus we can conclude that for the first three items, the results give some support to the price adjustment hypothesis for absolute magnitudes. There is no such support, however, from the fourth item - tomatoes.

So far as the rainfall coefficients are concerned, the signs, as noted above, are what we would expect, but the 't' statistics are in most cases too low for the coefficients to have any significance.

Turning now to the acreage results, we find some improvement in the R^2s. The signs of the price coefficients are right, and the erratic ones for the rainfall are not too worrisome as one does not expect a direct relation between rainfall and acreage as one does between rainfall and output. Moreover the 't' statistics for rainfall are too low for them to have any significance. On the other hand the 't' statistics for price coefficients show a marked improvement over the quantity results. Thus we could conclude that the acreage has shown more adjustment than output, as we expect in the (short-run) regression analysis. However, this clear-cut conclusion has to be modified by the existence of somewhat less favourable D-W statistic in the first two cases (as well as the last, which has too low D-W in the quantity results as well), which shows that the improvement in R^2 and 't' noted above is associated with (and many have partly resulted from) a higher degree of autocorrelation. Hence, it is not quite clear that taken as a whole, the acreage results provide a much better support to the adjustment hypothesis. Therefore all we can conclude is that the prediction of simple economic theory, that the absolute quantities of output

and acreage respond positively to absolute prices in the short run, gets some support from the results for Syria.

Table 2. Regression results (for absolute magnitudes) for Syria, 1966-77*

	Quantities				Acreage			
	Price (lagged)	Rain-fall	R^2	D-W	Price	Rain-fall	R^2	D-W
Wheat	61.32 (2.54	1.64 (0.94)	0.43	2.63	32.88 (2.77)	-0.64 (-0.76)	0.50	1.51
Barley	28.11 (2.05)	1.705 (1.73)	0.42	3.07	25.58 (2.06)	-1.255 (-1.33)	0.44	1.72
Sesame	0.31 (3.05)	0.01 (0.61)	0.57	1.93	0.70 (3.24)	0.02 (0.55)	0.60	2.62
Tomatoes	22.15 (1.07)	0.30 (0.41)	0.12	0.55	1.213 (2.32)	-0.01 (-0.25)	0.37	0.79

Source: As in table 1.

*For sesame seeds the period of study is 1966-75

Table 3 does not deserve any detailed comment. We can see at once that not only the R^2s are low but also most of the price coefficients, both in the quantities and acreage studies are of wrong sign and in any case the 't's are too low for them to have any significance. The relatively adequate D-W for most of the quantity relations as well as for some acreage relations are no help; as they only tell us that besides the variables being unrelated to each other, their errors are also unrelated to their past. The simple conclusion is that the short run study of relative magnitudes does not support any hypothesis based on the adjustment presumption.

Table 3. Regression results (for relative magnitudes) for Syria, 1966-77*

	Quantities				Acreage			
	Price (lagged)	Rain-fall	R^2	D-W	Price	Rain-fall	R^2	D-W
Wheat/ barley	-0.97 (-0.71)	-0.01 (-1.51)	0.20	2.41	0.441 (0.73)	0.00 (0.64)	0.11	1.71
Wheat/ sesame	-282.43 (-1.98)	-0.12 (-0.68)	0.36	2.12	-222.7 (-0.85)	-0.30 (-1.32)	0.23	1.36
Wheat/ tomatoes	0.30 (0.57)	-0.01 (1.23)	0.17	2.46	-1.88 (-0.42)	-0.05 (-1.07	0.12	1.32
Barley/ sesame	-169.11 (-0.94)	0.17 (1.48)	0.29	2.32	-444.4 (-1.72)	-0.36 (-2.11)	0.46	1.97
Barley/ tomatoes	-0.02 (-0.05)	-0.01 (2.39)	0.39	2.18	-4.41 (-0.76)	-0.09 (-1.71)	0.26	1.84
Sesame/ tomatoes	-0.00 (0.63)	-0.00 (0.08)	0.06	0.52	0.07 (0.95)	0.00 (0.39)	0.12	2.18

Source: As in table 1.

* For sesame seeds and all the ratio in which it enters, the period studied is 1966-75.

C. Summary of the Results on Syria

1.. The hypothesis that the trends of the quantity of a crop or its acreage has the same sign as that of its absolute price is not supported by the evidence for Syria (Table 1, columns 1-4).

2. The hypothesis, that the trends of the relative quantities of the crops or their relative acreage have the same sign as the trend of the relative prices, gets some support from the evidence (Table 1, columns 5-10).

3. The hypothesis that the quantity of a crop or its acreage may be related to the absolute price of that crop, in the short

run, gets some mild support from the regression analysis (Table 2).

4. The hypothesis that the relative quantities of the crops or their relative acreage may be related to their relative prices in the short run gets no support from the regression analysis (Table 3).

There is no doubt that whatever support is provided by the Syrian case to the adjustment hypothesis is weak. However, the cases in which this support is provided are those which appear *a priori* reasonable. We find that for the trend analysis, the support for adjustment comes from relative magnitudes and not from absolute magnitudes. This is what we expected to happen, for the reasons already cited in F. of Chapter I. Again the support for adjustment in the short period comes from the analysis of absolute magnitudes rather than of relative ones. This again is a possibility we noted in that section. Thus, although the support for adjustment hypothesis for Syria is weak, it is at the right places and cannot be quite ignored.

III. OUTPUT ADJUSTMENT ANALYSIS FOR IRAQ

A. The Broad View

The broad or long run of Iraq's agriculture is represented in Table 4. We find that the trends of absolute prices and quantities (as well of acreage) were in the same direction (have the same sign) in four out of four cases. (see columns 1-4). Hence there is substantial support for the adjustment hypothesis from the trend results of absolute magnitudes.

Turning to relative magnitudes (columns 5-10) we find that in only four out of six cases do the trends of quantities (and acreage) and prices have the same sign. The relative magnitudes, therefore, provide a weaker support, (if they provide any support at all) to the adjustment hypothesis than the absolute magnitudes.

Hence, it would appear that the relative strength of the support to the adjustment hypothesis with the help of trend analysis provided by the absolute approach is distinctly superior to that of the support provided by the relative (ratios) approach - somewhat contrary to our expectation in Section F of Chapter I. This conclusion is only slightly modified by the fact that 1972 is a rather odd year for wheat (see statistical Appendix tables 5 to 7) in Iraq, and all the figures (price, quantity and even acreage) for that year are quite out of line with, and do not appear to belong to, the same set of figures. If we exclude the wheat figures for 1972 (and the ratios they generate) and take the series only up to 1971, we find that in absolute approach, the price trends have still the same sign as the quantity trends in four out of four cases, but have the same sign as the acreage trend in only three out of four cases. On the other hand, in terms of relative magnitudes, the price ratios have the trend of the same sign as the quantity and acreage ratios in five out of six cases, instead of four out of six cases when the series was taken up to 1972. Hence, even for the wheat series up to 1971, the support

given to the adjustment hypothesis by absolute magnitudes is still superior to that given by the relative magnitudes.

Table 4. Trend analysis for Iraq 1960-72*

(Percentage exponential rate of growth)

	1 Wheat = W	2 Barley = B	3 Rice = R	4 Tomatoes = T	5 W/B	6 W/R	7 W/T	8 B/R	9 B/T	10 R/T
Quantity or quantity ratios	7.1	-1.6	10.2	9.0	8.8	-3.1	-0.3	-11.8	- 9.6	- 3.8
Price or price ratios	5.2	-1.3	0.1	9.5	6.5	5.1	2.1	- 1.3	-13.5	-12.9
Acreage or acreage ratios	0.7	-5.9	1.8	5.1	6.6	-1.2	-7.1	- 7.7	-15.2	- 8.1

Source: Appendix tables 5 to 8.

However, the main point is that Iraq's trend figures do provide support to the adjustment hypothesis in the long run. The support is not weaker, and, taken as a whole probably stronger than that provided by the trends analysis of Syria.

B. Regression Analysis for Iraq

Let us examine the regressions, in terms of absolute magnitudes, in Table 5. We can immediately see that the R^2s are low, in most cases. However, much more damaging to the adjustment hypothesis for the short run in that the signs of three out of four price coefficients in both quantity and acreage study are "wrong". The only item with the right sign for the price coefficient is tomatoes. But the R^2 for this equation is almost zero, and the 't' statistic is too low for the coefficients to have any significance.

Turning now to the analysis of relative magnitudes we find that in most cases in Table 6, the R^2s are lower. However, the price

Table 5. Regressing results (for absolute magnitudes) for Iraq, 1966-77

Item	Quantity				Acreage			
	Price (Lagged)	Rainfall	R^2	D-W	Price	Rainfall	R^2	D-W
Wheat = W	-11.75 (-0.56)	1.74 (1.01)	0.16	2.27	-8.24 (-0.73)	1.77 (2.03)	0.32	3.15
Barley = B	-12.48 (-1.48)	1.14 (1.82)	0.39	1.48	-9.06 (-0.92)	0.68 (0.87)	0.15	0.53
Rice = R	-4.56 (-3.09)	0.37 (1.57)	0.54	1.35	-1.84 (-4.27)	0.03 (0.40)	0.67	1.08
Tomatoes = T	1.45 (0.53)	-0.11 (-0.46)	0.06	1.29	0.18 (0.82)	0.01 (-0.24)	0.07	1.35

Source: The same as in Table 4.

Table 6. Regression results (for relative magnitudes) for Iraq, 1966-77

Item	Quantity				Acreage			
	Price (Lagged)	Rainfall	R^2	D-W	Price	Rainfall	R^2	D-W
W/B	0.25 (1.61)	0.00 (0.74)	0.22	1.76	0.178 (1.32)	-0.00 (-0.19)	0.16	1.04
W/R	2.74 (0.31)	0.20 (0.93)	0.10	1.21	-6.66 (-0.31)	0.04 (0.89)	0.08	0.98
W/T	0.05 (0.05)	0.01 (1.59)	0.23	2.42	12.22 (1.62)	0.03 (0.73)	0.34	0.80
B/R	-7.23 (-1.77)	0.00 (0.63)	0.32	1.59	1.45 (0.15)	0.01 (0.73)	0.06	1.14
B/T	2.19 (2.73)	0.00 (1.20)	0.55	1.61	21.51 (3.56)	0.01 (0.63)	0.60	2.06
R/T	0.12 (1.41)	0.00 (0.48)	0.28	1.15	0.47 (2.35)	0.00 (0.96)	0.39	0.86

Source: The same as in Table 4.

coefficient have the right sign in five out of six cases in both the quantity and the acreage study. But, except for barley/tomatoes for the quantity analysis, and barley/tomatoes and rice/tomatoes for the acreage analysis the 't' statistics are too low for the price coefficients to be significant. Thus we are left with three possible price coefficients out of twelve which may lend support to the adjustment hypothesis for the relative magnitudes in the short run. However, the equations have too low D-W for one of these three, indicating a rather too high auto-correlation for the results to have much significance, while another D-W is only slightly better. Thus only one, out of the possible twelve coefficients, which could lend support to the adjustment hypothesis, actually does so. This is the price coefficient of barley/tomatoes in the acreage equation, which also has the highest R^2 in the whole set.

It is clear that this isolated positive result, which appear more to be an exception than a rule, can provide little support to the adjustment hypothesis in the short run for Iraq.

C. Summary of the Results on Iraq

1. The hypothesis that the trend of the quantity of a crop or its acreage has the same sign as that of its absolute prices is supported by the evidence of Iraq. (Table 4, Columns 1-4).

2. The hypothesis that the trend of the relative quantities of a crop or its acreage has the same sign as that of the relative prices also gets some, rather weak, support from the evidence (Table 4, Columns 5-10, and the discussion which follows).

3. The hypothesis that the quantity of a crop and its acreage may adjust to its absolute price in the short run gets no support from the regression analysis. (Table 5).

4. The hypothesis that the relative quantities of the crops or their relative acreage may adjust to their relative prices in the short run gets little or no support from the regression analysis (Table 6).

Thus the evidence on the long run adjustment hypothesis is stronger for Iraq than for Syria, but it is much weaker than Syria (in fact, non-existent) for the short run adjustment hypothesis.

IV. OUTPUT ADJUSTMENT ANALYSIS FOR JORDAN

A. The Broad View

In this broad view or long run analysis, of Jordan's agriculture, as represented by Table 7, we find that in three out of four cases the quantities and acreages move in a direction which is opposite to that of absolute prices. (Columns 1-4). Thus, in place of supporting the long run adjustment hypothesis, the results from absolute magnitudes appear to support the reverse.

Turning to the relative magnitudes, we find that the relative quantities move in the same direction as relative prices in only three out of six cases, while the relative acreages move in the same direction as relative prices in only one out of six cases and hence moves in the opposite direction in five out of six cases. Thus the adjustment hypothesis does not get any greater support from relative magnitudes either.

Thus, whatever evidence is provided by the long run view indicates that there is no support for the long run adjustment hypothesis from Jordan's evidence. In fact, one may conclude, even if very tentatively, the opposite of the adjustment hypothesis from the above evidence.

B. Regression Analysis for Jordan

We should note, before analysing the results of Table 7 in any detail, that rainfall has not been incorporated in the regressions for Jordan. This is because the rainfall figures were available only for the period 1974-77. Hence, Jordan's results are not strictly comparable to those of the other countries. In particular the R^2s for Jordan would appear lower than what they would have been, had the rainfall been treated as another independent variable.

Having said that, when we look at the R^2s, we find that so low that they are unlikely to have become comparable, let us say to Syrian results, even if the regressions for Syria were also obtained without incorporating rainfall.[1/]

1/ In fact they are not.

Table 7. Trends analysis for Jordan, 1960-72*

	1 Wheat = W	2 Barley = B	3 Tomatoes = T	4 Grapes = G	5 W/B	6 W/T	7 W/G	8 B/T	9 B/G	10 T/G
Quantity or quantity ratios	3.9	-4.1	-5.1	-1.4	8.0	-2.1	18.5	-13.6	10.5	15.9
Price or price ratios	2.7	2.7	3.9	4.9	0.1	-1.4	-2.2	-3.2	-2.9	-1.7
Acreage or acreage ratios	1.7	-2.7	-6.5	-14.9	3.8	3.7	16.9	0.1	13.1	14.0

Source: Statistical Appendix tables 9 to 11.

*Tomatoes and the ratios into which they enter the period cover 1964-72

What is intriguing however, although, as we shall see later, not significant from the strictly statistical point of view, is the fact that the signs of all the price coefficients are the opposite of what the adjustment hypothesis requires to be! In fact they are more in conformity with the slightly move sophisticated economic theory which postulates that the supply curve may be negatively inclined, if, for example, farmers attempt to achieve a particular standard of life which may be attained with a lower output when its price goes up in the market. However, as we not only have very low R^2s, but the 't' statistics also are below the acceptable level, while the D-W statistic is lower than 2 for two items. The results, therefore, cannot be considered statistically significant.

Turning to the results for relative magnitudes as presented in Table 9, we find that the results are almost perfect examples of non-relations. The R^2s are unbelievably low, the sign of the coefficients are perfectly equally divided between ayes and nos, and that 'ts' also are all below the point of significance and most of them very much lower. In this situation an acceptable D-W illustrates, as mentioned earlier, only another type of non-relation, in this case, over time.

Table 8. Regression results (for absolute magnitudes) for Jordan, 1966-77.

Item	Quantity			Acreage		
	Price (Lagged)	R^2	D-W	Price	R^2	D-W
Wheat	-3.61 (-1.22)	0.13	3.04	-3.38 (-1.70)	0.22	2.60
Barley	-0.22 (-0.13)	0.00	2.61	-2.19 (-1.73)	0.23	2.09
Tomatoes	-5.58 (-1.04)	0.10	1.84	-0.20 (-0.44)	0.02	1.03
Grapes	-1.19 (-1.37)	0.16	1.08	-0.23 (-1.00)	0.09	1.41

Source: As in Table 7.

Table 9. Regression results (for relative magnitudes) for Jordan, 1966-77

Item	Quantity			Acreage		
	Price (Lagged)	R^2	D-W	Price	R^2	D-W
Wheat/ Barley	-0.253 (-0.58)	0.03	1.53	0.064 (0.28)	0.01	2.18
Wheat/ Tomatoes	-0.068 (-0.51)	0.03	2.87	-0.028 (-0.03)	0.00	2.30
Wheat/ Grapes	-1.391 (-0.02)	0.01	2.40	9.347 (0.48)	0.02	2.40
Barley/ Tomatoes	0.020 (0.41)	0.02	3.03	-0.39 (-0.70)	0.06	2.93
Barley/ Grapes	2.881 (1.72)	0.23	2.14	-7.059 (-0.83)	0.06	2.23
Tomatoe/ Grapes	2.497 (0.37)	0.01	1.78	2.300 (1.19)	0.12	2.70

Source: As in Table 7.

C. Summary of the Results on Jordan

1. There is no support for the long run adjustment hypothesis from the trends of absolute prices, quantities and acreage. If anything, the reverse of this hypothesis, viz. a rise in price is associated with a fall in the amount supplied (and acreage covered) seems to be supported by the evidence (Table 7).

2. There is no support for the long run adjustment hypothesis from the trends of relative prices, quantities and acreage (Table 7).

3. There is no support for the short run adjustment hypothesis from the regression analysis of absolute prices, quantities and acreage. In fact there is a suggestion, even if strictly not significant, that the opposite hypothesis may have some support from the evidence (Table 8).

4. There is no support for the short run adjustment hypothesis from the regression analysis of the relative magnitudes either. The figures, in fact, appear to have been chosen almost randomly (Table 9).

In brief then, there is no support from Jordan's evidence for either the short run or the long run adjustment hypothesis. In fact, there is some suggestion, even if statistically not significant, that the reverse may have been true.

V. OUTPUT ADJUSTMENT ANALYSIS FOR SAUDI ARABIA

A. The Broad View

In case of Saudi Arabia only three major crops: wheat, tomatoes and barley have usable information. The trend results of these crops are presented in Table 10.

Columns 1 to 3 of the table represent the trends of absolute magnitudes, while columns 4 to 6 present those of the relative magnitudes.

We find that the trends of both the quantities and acreage have the same signs as those of absolute prices in two out of three cases, while in only one of the three cases do the relative quantities and acreage move in the same direction as relative prices. There is thus little, if any, support for the long run adjustment hypothesis from the above results, particularly when we recall (from Section F of Chapter I) that it is relative rather than absolute magnitudes which are more likely to adjust in the long run.

B. Regression Analysis for Saudi Arabia

Turning to the regression analysis of absolute magnitudes, we find that the R^2s are not very low, considering the other results of this study. However, the sign of one price coefficient out of three is wrong in the quantity regressions and two out of three are wrong in the acreage regression. Thus, taken together three out of six signs are wrong. When we recall (for Chapter I) that the acreage approach is at least as pertinent as the quantity approach, we cannot adduce any support for the adjustment from the above results. Moreover, in accepting the quantity results, we would also have to accept two out of three 'wrong' signs for rainfall. The sign is wrong in the sense that it implies that in Saudi Arabia, of all places, the quantities produced decrease with the increase in rainfall. It may be noted, that for Syria and Iraq, the relation between (absolute) output and rainfall is positive in almost all cases.

Table 10. Trends analysis for Saudi Arabia, 1961-72*

	1 Wheat	2 Tomatoes	3 Barley	4 W/T	5 W/B	6 T/B
Quantity or quantity ratios	1.8	4.9	-3.8	-3.6	5.5	11.2
Price or price ratios	0.9	1.6	2.8	-1.2	-2.0	-0.9
Acreage or acreage ratios	2.7	9.3	-5.3	-5.7	8.0	16.9

Source: Statistical Appendix tables 13 to 15.

*No figures available for 1960. Tomatoes and the ratios into which they enter cover 1964-72 period.

Now turning to the regressions in relative magnitudes, as represented in Table 12, we find that the results do not lend any support to the short run adjustment hypothesis. Many of the R^2s, particularly of the acreage regressions are fairly high, but if they are accepted, it is not the adjustment hypothesis, but its opposite which gets support from them, as the sign of five out of six price coefficient is negative. However, as most of the 'ts' are unacceptably low, in fact only two of the acreage price coefficient, and none of the quantity price coefficient have acceptable 't' statistic. Moreover, as all the D-Ws are below the required level and in particular the D-Ws for one of the two price coefficient for which 't' is acceptable are very low indeed, the results are statistically not at all conclusive, and they may, at best be considered only suggestive.

C. Summary of the Results on Saudi Arabia

1. There is no support to the long term adjustment hypothesis, when the magnitudes are taken in absolute terms (Table 10).

2. There is no support for the long run adjustment hypothesis when the magnitudes are taken in relative terms (Table 10).

Table 11. Regression results (for absolute magnitude) for Saudi Arabia, 1966-74*

Item	Quantity				Acreage			
	Price (Lagged)	Rainfall	R^2	D-W	Price	Rainfall	R^2	D-W
Wheat	6.85 (1.74)	0.10 (0.60)	0.34	2.17	-2.35 (-1.20)	0.15 (1.16)	0.42	2.60
Tomatoes	3.86 (0.95)	-0.19 (-2.25)	0.56	2.64	0.63 (1.14)	-0.01 (-0.4)	0.28	1.86
Barley	-2.13 (-1.85)	-0.01 (-0.32)	0.37	1.12	-1.34 (-3.24)	0.03 (-1.14)	0.64	1.50

Source: As in Table 10.

*Rainfall figures are available only up to 1974.

Table 12. Regression results (for relative magnitudes) for Saudi Arabia, 1966-74*

Item	Quantity				Acreage			
	Price (Lagged)	Rainfall	R^2	D-W	Price	Rainfall	R^2	D-W
Wheat/ tomatoes	0.84 (0.78)	0.01 (2.47)	0.51	1.68	-8.32 (-1.03)	0.06 (2.18)	0.56	1.78
Wheat/ barley	-0.37 (-0.14)	0.00 (0.28)	0.03	1.14	-5.16 (-2.87)	0.02 (1.73)	0.66	1.44
Tomatoes/ barley	-1.74 (-1.36)	-0.01 (-0.86)	0.27	0.74	-0.50 (-3.29)	0.00 (0.00)	0.64	0.98

Source: As in Table 10.

*Rainfall figures are available only up to 1974.

3. There is no support for the short run adjustment hypothesis when the magnitudes are taken in absolute terms (Table 11).

4. There is no support for the short run adjustment hypothesis when values are taken in relative terms. One may even claim that in this case there may be some evidence, even if only suggestive, in support of the reverse of the adjustment hypothesis, particularly for the acreage results (Table 12).

VI. SUMMARY, CONCLUSIONS AND CAVEATS

1. Before we summarise the findings, a point made earlier must be reiterated regarding the quality and the nature of the data on which these findings are based. The data had to be collected from different, not always comparable sources (as the wheat data for Iraq for 1972 seem to illustrate. See comments on this in Chapter III). Moreover, the prices used in the analysis are the import prices being the only reliable series of prices available. However, they are by no means the most relevant prices to which all the farmers should be expected to respond. Finally, the series cover too short a period for drawing any firm conclusions. Hence the results obtained in this study should be considered only tentative, awaiting further confirmation. Having once said this, I shall take this as granted in what follows; and, to avoid monotony, shall not keep on repeating the caveats on every possible occasion.

2. We may summarise our finding by stating that the usual hypothesis of the simple economic theory, that the suppliers attempt to supply more of their product when its price is higher, gets very little support for the evidence analysed here. It does get some mild support from the long run analysis for Syria and Iraq, and for the short run analysis for Syria alone. However, in view of the thinness of the support where it exists, and also in view of the number of cases where the hypothesis is not supported at all by the evidence, so much so that in some cases the results support the reverse of the hypothesis, we cannot but reach the conclusion we have done at the beginning of this paragraph.

3. As stated in the Introduction to the Study, a negative conclusion, that is a conclusion which does not support a generally believed economic hypothesis, is at least as useful, as, and sometimes more so than, a positive conclusion. This is because a positive conclusion only supports the already accepted view which the policy makers were presumably taking for granted even without the

study. Hence, whether the study were undertaken or not would not really matter. On the other hand, a negative conclusion would require the policy makers to rethink the entire situation and presumably to change their policies in the light of the findings.

4. The recommendations made here will simply be an amplification of some of the consequences of the negative findings of the study. They are:

a) As the results directly depend on the data for these countries, every effect should be made to improve it and to reexamine the whole situation when the improved data are available.

b) We can conclude, from the evidence available so far, that the usual market forces, and particularly the price signals for outputs are not likely to be adequate for changing supplies of agricultural outputs in these countries. Even for Syria and Iraq, they are not strong enough even to form a basis of long run policies; they are even weaker for short run policies.

c) The inadequacy of price signals from the market does not imply that prices do not affect outputs. It is quite possible that the farmers do not believe that the price experience of the past is a good guide to the future prices (after all, the stock examples in the cobweb therein are taken from agriculture and the farmers may be familiar with its conclusions!). Thus it is possible that a policy of guaranteed prices may be a better instrument than market prices for influencing supplies.

d) Moreover, it is possible that a less speculative price mechanism, or policies which are somewhat outside the price mechanism, may still affect the suppliers' behaviour. The provision of farm inputs, such as that of fertilizers at low prices, can be an example of the former and possible changes in the land tenure system with a view to improving the efficiency of production through appropriate incentives is an example of the latter.

e) Incentives can also be used differentially. For example, providing fertilizer particularly suited for one or more crop is likely to increase its supply as compared to what they would have otherwise been. So may the provision of water in areas particularly suited for a particular kind of crop increase the supply of that crop.

f) All the above recommendations for more direct incentives are subject to the overall provision of the adequacy of the administrative machinery to implement them. For instance, assuring guaranteed price may require a different type and extent of administrative machinery than providing water for irrigation. In deciding whether to choose one or the other one would depend partly on the relative efficiency of the administrative machinery in implementing them.

g) Furtherance, the policy adopted may differ according to whether the problem is a short run or long run one. The examples in f) illustrate this point as well. A policy of guaranteed price may have short run effect, while the policy for providing better water facilities may take much longer and may be only a suitable part of a long run policy.

h) In brief, the evidence of the present study throws considerable doubt on the efficacy of the market mechanism in changing the output supplied in the desired direction in those countries. Hence, these countries may have good reasons to look for alternative ways of changing these supplies.

APPENDIX

The table which follows presents the 't' statistic for the coefficients of important predetermined variables for the four countries we have studied, when we adopt the adaptive expectation approach. This approach is based on the assumption that economic agents base their decision of production not only on the price experience of that period or of the immediately preceeding period, but also on the price experience of the more distant past. However, the weight assigned to the price experience of the past diminishes in influence, in a specified way, as the time distance becomes longer. As a result of this assumption, it is possible to capture the effect of the past prices (independent variable) by the lagged value of the dependent variable itself. We can get the following two equations through this approach:

$$Q_t = a_o + a_1 P_{t-1} + a_2 Q_{t-1} + a_3 N_t \quad (1)$$

and

$$A_t = b_o + b_1 P_t + b_2 A_{t-1} + b_3 N_t \quad (2)$$

where Q_t, A_t, P_t represent quantities of outputs, their acreages and prices respectively in period 't', either in absolute or relative terms, while N's stand for rainfall. The different time subscript for P in (1) and (2) indicates that while a one-periods lag has been assumed between the most recent relevant price and the quantity produced, no such lag has been assumed between this price and the acreage used. The 't' statistics for the coefficients of N have not been given in the following table, as they do not directly bear on the issues discussed here.

We cannot go here into any detailed technical explanation of the derivation of (1) and (2) from the underlying adaptive expectation approach. If needed, they may be looked up in most standard texts on econometrics. For our purposes, it is sufficient to note that the coefficient of P's on the R.H.S. represent the influence of the most recent price, while the coefficients of Q_{t-1} in equation

(1) and of A_{t-1} in equation (2) attempt to capture the influence of the more distant prices, even though on the surface they are simply lagged values of the dependent variables in the two equations. In our terminology, and even at the risk of being not quite accurate, we may say that the P's represent the "short run" influence of prices while the Q_t and A_t attempt to present the long run influence of prices.

As stated earlier, the table below presents only the 't' statistic. Although R^2 are important and even D-W may have some role in helping evaluate the strength of the relationships, it is 't' statistic which we finally look up for policy purposes, because it goes beyond the significance of the relationship's in general, and deals with the significance of the predetermined variables separately which alone can be used as instruments of policy. Incidentally, the sign of 't' statistic on the table also indicates the sign of the coefficients of these variables.

In the table the numbers in the first column (entitled Items) represent various outputs in order of their importance for each country as indicated in the respective chapters in the text. For instance, 3 in column 1 represents sesame for Syria, but rice for Iraq, and 3/4 in Column 1 means sesame/tomatoe for Syria, but rice/tomatoe for Iraq.

It can be easily seen that very few 't' fulfil the crude criterion of significance of having an absolute value larger than 2. Even those which do, barely make it, and a few among them have the wrong sign. To be specific, out of 144 'ts' only 21 have 'ts' with absolute values larger than 2 and 4 of these 'ts' have the wrong (negative) sign. 17 out of 144 is indeed a poor score. When we realize that the significance of 't' statistic does not by itself,

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1/ As the regression model is using the lagged value of the endogenous variables as explanatory variables, the D-W would be biased towards 2 and give overoptimistic results, but as we have not used these numbers in any case, this should not worry us too much.

ADAPTIVE EXPECTATION APPROACH TO ADJUSTMENT

't' Statistic for Syria, Iraq, Jordan and Saudi Arabia

ITEMS	't' STATISTIC															
	SYRIA				IRAQ				JORDAN				SAUDI ARABIA			
	Quantity		Acreage		Quantity		Acreage		Quantity		Acreage		Quantity		Acreage	
	P_{t-1}	Q_{t-1}	P_t	A_{t-1}	P_{t-1}	Q_{t-1}	P_t	A_{t-1}	P_{t-1}	Q_{t-1}	P_t	A_{t-1}	R_{t-1}	Q_{t-1}	P_t	A_{t-1}
1	2.34	-1.46	1.67	-0.09	-0.34	-0.18	-1.81	-1.75	-1.52	-1.65	-1.54	-0.52	-0.61	-1.38	-2.00	-1.70
2	1.52	-0.85	1.23	-0.94	-0.80	-0.36	0.32	3.53	-0.31	-0.77	-1.44	0.37	1.04	-1.06	0.26	0.77
3	2.67	-0.48	2.42	-0.23	-1.76	-0.12	-2.04	1.17	-0.92	0.02	0.49	2.05	0.52	1.53	-1.54	0.44
4	-0.41	4.73	-0.44	3.03	-0.55	0.60	0.07	1.06	-0.01	3.85	0.02	2.13				
1/2	-0.81	-0.02	-0.66	-0.91	0.64	1.42	1.14	2.39	-0.58	0.87	0.27	-0.12	0.26	-0.43	-0.69	0.08
1/3	-1.93	-0.57	-0.42	1.02	0.24	1.35	0.01	1.82	-0.22	-1.58	-0.16	-0.60	0.63	0.96	-2.53	0.25
1/4	0.48	-0.37	-1.28	-0.60	0.12	-0.15	1.46	2.51	-0.14	-0.54	0.41	-0.42	0.78	2.32	-1.47	0.99
2/3	-0.97	-0.41	-1.55	0.14	-1.54	0.91	-1.57	2.37	0.20	-1.37	-0.99	-1.69				
2/4	0.26	0.87	-0.70	-0.60	1.08	2.70	0.64	2.11	1.62	-2.9	-0.82	-0.60				
3/4	1.08	1.58	0.66	0.30	0.84	2.53	0.58	2.94	0.09	0.57	1.15	-0.33				

Source: Derived from Appendix tables 1 to 16.

support the adjustment hypothesis and we further require high values for R^2 and near-2 values for D-W, a condition which is only occasionally fulfilled, the poverty of the score becomes even more manifest. Hence, in general, the results support the conclusions reached in Chapter VI.

The conclusions of Chapter VI are supported even in more detail when we see that out of the 17 significant coefficient with correct sign, 14 relate to what we may consider, the "long run" influence of price, Q_{t-1} and A_{t-1}. Thus whatever little support is available for the adjustment hypothesis from the evidence presented, it applies to the long run rather than the short run. This also conforms to the conclusions in Chapter VI.

We may therefore conclude that the results summarized in Chapter VI remain essentially unchanged when we introduce adaptive expectation approach instead of the simplier approaches used in the text.

Table 1. Import prices for Syria (in US$ per 100 Kgs.)

Year	Wheat	Barley	Sesame	Tomatoes
1960	6.7	0.0	18.3	0.0
1961	6.3	4.0	22.7	0.0
1962	6.8	5.2	22.7	0.0
1963	8.0	4.7	20.6	0.0
1964	9.4	5.2	22.9	6.6
1965	11.1	5.3	21.8	6.2
1966	7.4	5.8	22.5	6.1
1967	6.7	5.7	27.6	7.2
1968	6.3	5.1	24.3	7.1
1969	6.3	3.6	20.9	12.6
1970	7.0	5.4	26.8	6.8
1971	7.9	6.9	32.6	7.4
1972	7.0	6.1	30.6	11.7
1973	13.3	10.1	35.0	6.6
1974	23.2	17.6	51.3	7.2
1975	16.8	17.2	58.9	7.5
1976	12.9	16.8	0.0	13.5
1977	10.8	16.4	0.0	16.5

Source: See Appendix table 17.

Table 2. Quantities produced by Syria (in 000' metric tons)

Year	Wheat	Barley	Sesame	Tomatoes
1960	555.0	156.0	3.7	75.0
1961	757.0	335.0	4.2	93.0
1962	1374.0	798.0	5.9	116.0
1963	1190.0	784.0	5.3	116.0
1964	1100.0	637.0	6.5	153.0
1965	1044.0	690.0	4.9	135.0
1966	559.0	203.0	8.9	126.0
1967	1049.0	590.0	7.9	162.0
1968	600.0	512.0	6.4	184.0
1969	1004.0	627.0	5.9	192.0
1970	625.0	235.0	3.0	192.0
1971	662.0	123.0	4.0	248.0
1972	1808.0	710.0	10.0	316.0
1973	593.0	102.0	5.0	269.0
1974	1630.0	656.0	13.0	396.0
1975	1550.0	596.0	14.0	375.0
1976	1790.0	1059.0	19.0	517.0
1977	1217.0	337.0	20.0	550.0

Source: See Appendix table 17.

Table 3. Acreage in Syria (in 000' Ha)

Year	Wheat	Barley	Sesame	Tomatoes
1960	1550.0	742.0	7.0	8.0
1961	1315.0	727.0	7.0	11.0
1962	1417.0	723.0	8.0	14.0
1963	1559.0	803.0	7.0	23.0
1964	1476.0	765.0	10.0	19.0
1965	1214.0	682.0	7.0	17.0
1966	853.0	336.0	6.0	15.0
1967	1201.0	646.0	12.0	18.0
1968	891.0	631.0	13.0	18.0
1969	1221.0	626.0	10.0	17.0
1970	1341.0	1126.0	6.0	16.0
1971	1274.0	435.0	10.0	20.0
1972	1354.0	593.0	33.0	22.0
1973	1476.0	914.0	15.0	21.0
1974	1537.0	697.0	34.0	30.0
1975	1692.0	1011.0	31.0	27.0
1976	1590.0	1172.0	43.0	32.0
1977	1528.0	1021.0	45.0	35.0

Source: See Appendix table 17

Table 4. Rainfall (in mm's) in Syria

Year	
1966	257.5
1967	431.3
1968	418.6
1969	401.6
1970	214.6
1971	389.8
1972	307.1
1973	236.0
1974	377.1
1975	285.0
1976	335.7
1977	308.9

Source: See Appendix table 17

Table 5. Iraq import prices (US$ per 100 Kgs.)

Year	Wheat	Barley	Rice	Tomatoes
1960	7.3	5.0	14.3	0.0
1961	6.8	4.5	16.6	0.0
1962	7.0	5.0	17.8	0.0
1963	7.3	5.4	18.7	0.0
1964	8.1	5.7	17.4	4.8
1965	3.6	4.9	20.0	4.7
1966	7.0	5.7	33.3	4.5
1967	7.7	7.1	17.9	4.6
1968	7.3	4.8	17.7	4.6
1969	10.5	4.4	17.4	5.6
1970	7.7	4.2	11.6	5.6
1971	7.9	4.3	16.2	9.6
1972	22.6	4.4	21.0	10.0
1973	14.0	6.8	41.4	10.5
1974	24.0	10.4	53.1	23.4
1975	23.6	16.0	53.6	23.3
1976	22.9	27.8	43.5	24.8
1977	20.1	18.9	42.6	24.6

Source: See Appendix table 17

Table 6. Quantities produced in Iraq (in 000' metric tons)

Year	Wheat	Barley	Rice	Tomatoes
1960	592.0	804.0	118.0	0.0
1961	857.0	911.0	68.0	139.0
1962	1085.0	1125.0	113.0	140.0
1963	499.0	790.0	143.0	143.0
1964	807.0	623.0	184.0	189.0
1965	1005.0	807.0	178.0	190.0
1966	826.0	832.0	182.0	216.0
1967	860.0	855.0	308.0	241.0
1968	1537.0	992.0	354.0	232.0
1969	1183.0	963.0	318.0	220.0
1970	1236.0	682.0	180.0	311.0
1971	822.0	432.0	307.0	383.0
1972	2625.0	980.0	268.0	368.0
1973	957.0	462.0	157.0	355.0
1974	1339.0	533.0	68.0	400.0
1975	845.0	437.0	61.0	258.0
1976	1312.0	579.0	163.0	350.0
1977	696.0	458.0	199.0	290.0

Source: See Appendix table 17

Table 7. Acreage in Iraq (in 000' Ha)

Year	Wheat	Barley	Rice	Tomatoes
1960	1271.0	1038.0	76.0	0.0
1961	1346.0	1041.0	64.0	20.0
1962	1591.0	1189.0	91.0	22.0
1963	1705.0	1219.0	108.0	23.0
1964	1627.0	1098.0	109.0	28.0
1965	1705.0	1097.0	114.0	27.0
1966	1737.0	1169.0	111.0	28.0
1967	1842.0	1087.0	141.0	32.0
1968	1684.0	903.0	109.0	31.0
1969	1661.0	845.0	106.0	29.0
1970	1759.0	673.0	75.0	36.0
1971	948.0	396.0	109.0	37.0
1972	1915.0	726.0	94.0	43.0
1973	1156.0	464.0	64.0	43.0
1974	1633.0	519.0	31.0	45.0
1975	1408.0	567.0	30.0	29.0
1976	1499.0	576.0	52.0	38.0
1977	1300.0	700.0	63.0	32.0

Source: See Appendix table 17

Table 8. Rainfall (in mm's) in Iraq

Year	
1966	294.9
1967	471.1
1968	408.6
1969	531.7
1970	275.4
1971	298.4
1972	441.7
1973	227.1
1974	498.9
1975	378.8
1976	390.6
1977	340.3

Source: See Appendix table 17

Table 9. Import prices in Jordan (in US$ per 100 kgs.)

Year	Wheat	Barley	Tomatoes	Grapes
1960	6.2	4.6	0.0	10.3
1961	6.7	5.3	0.0	8.6
1962	6.2	5.0	0.0	8.5
1963	6.6	5.5	0.0	8.7
1964	7.2	5.8	5.7	8.7
1965	7.3	5.0	5.8	11.0
1966	7.4	6.5	5.7	12.3
1967	6.7	7.2	7.4	11.1
1968	7.6	5.5	10.0	10.9
1969	8.5	5.7	11.5	16.8
1970	8.3	5.3	8.2	15.3
1971	8.7	6.8	6.2	16.2
1972	8.2	5.9	7.3	12.3
1973	15.6	12.1	7.2	15.8
1974	27.7	12.7	6.9	22.1
1975	20.0	12.9	6.4	22.7
1976	21.7	3.8	11.2	23.6
1977	14.6	15.0	13.0	29.9

Source: See Appendix table 17

Table 10. Quantitieslproduced in Jordan (in 000' metric tons)

Year	Wheat	Barley	Tomatoes	Grapes
1960	44.0	13.0	156.0	43.0
1961	138.0	62.0	214.0	78.0
1962	112.0	36.0	169.0	79.0
1963	76.0	23.0	215.0	59.0
1964	295.0	97.0	228.0	77.0
1965	278.0	95.0	189.0	80.0
1966	101.0	23.0	145.0	62.0
1967	196.0	63.0	216.0	28.0
1968	95.0	20.0	127.0	8.0
1969	159.0	42.0	150.0	14.0
1970	54.0	6.0	137.0	26.0
1971	168.0	26.0	137.0	19.0
1972	211.0	34.0	153.0	18.0
1973	50.0	6.0	83.0	22.0
1974	245.0	40.0	133.0	18.0
1975	50.0	12.0	145.0	11.0
1976	67.0	13.0	88.0	14.0
1977	53.0	12.0	88.0	14.0

Source: See Appendix table 17

Table 11. Acreage in Jordan (in 000' Ha)

Year	Wheat	Barley	Tomatoes	Grapes
1960	100.0	34.0	13.0	19.0
1961	273.0	95.0	19.0	21.0
1962	285.0	105.0	21.0	21.0
1963	206.0	76.0	21.0	21.0
1964	297.0	91.0	24.0	21.0
1965	279.0	86.0	21.0	21.0
1966	214.0	65.0	17.0	20.0
1967	226.0	58.0	17.0	5.0
1968	218.0	71.0	15.0	5.0
1969	164.0	56.0	21.0	4.0
1970	232.0	41.0	13.0	7.0
1971	244.0	53.0	13.0	4.0
1972	224.0	61.0	14.0	6.0
1973	113.0	19.0	13.0	4.0
1974	220.0	60.0	14.0	4.0
1975	119.0	30.0	10.0	7.0
1976	137.0	30.0	9.0	3.0
1977	132.0	29.0	9.0	5.0

Source: See Appendix table 17

Table 12. Rainfall (in mm's) in Jordan

Year	
1966	0.0
1967	0.0
1968	0.0
1969	0.0
1970	0.0
1971	0.0
1972	0.0
1973	0.0
1974	645.6
1975	307.9
1976	313.7
1977	327.4

Source: See Appendix table 17

Table 13. Import prices in Saudi Arabia (in US$ per 100 kgs.)

Year	Wheat	Tomatoes	Grapes	Barley
1960	6.3	0.0	9.5	5.9
1961	9.2	0.0	7.5	5.5
1962	9.2	0.0	27.5	5.3
1963	9.7	0.0	8.7	7.1
1964	11.1	10.1	8.0	7.5
1965	9.4	10.6	9.5	6.7
1966	10.2	20.4	19.0	6.7
1967	8.8	9.9	17.5	7.9
1968	10.4	10.9	14.9	5.7
1969	10.2	11.1	17.2	5.0
1970	9.7	11.7	20.4	6.1
1971	9.9	11.4	15.9	9.1
1972	11.1	11.1	14.0	10.0
1973	17.0	14.1	18.5	11.6
1974	20.0	14.1	20.0	17.5
1975	22.1	15.7	17.3	15.4
1976	23.1	15.9	19.3	16.1
1977	20.1	16.1	23.1	15.9

Source: See Appendix table 17

Table 14. Quantities produced in Saudi Arabia (in 000' metric tons)

Year	Wheat	Tomatoes	Grapes	Barley
1960	0.0	0.0	0.0	0.0
1961	120.0	44.0	0.0	32.0
1962	130.0	46.0	0.0	34.0
1963	135.0	46.0	0.0	35.0
1964	125.0	50.0	0.0	33.0
1965	148.0	82.0	0.0	32.0
1966	149.0	108.0	0.0	34.0
1967	150.0	100.0	0.0	34.0
1968	130.0	58.0	0.0	34.0
1969	150.0	100.0	0.0	34.0
1970	150.0	100.0	0.0	34.0
1971	150.0	80.0	24.0	18.0
1972	150.0	111.0	25.0	20.0
1973	90.0	100.0	25.0	18.0
1974	192.0	110.0	26.0	22.0
1975	132.0	301.0	61.0	17.0
1976	93.0	305.0	68.0	12.0
1977	135.0	310.0	70.0	15.0

Source: See Appendix table 17

Table 15. Acreage in Saudi Arabia (in 000' Ha)

Year	Wheat	Tomatoes	Grapes	Barley
1960	0.0	0.0	0.0	0.0
1961	85.0	4.0	0.0	26.0
1962	90.0	4.0	0.0	27.0
1963	100.0	4.0	0.0	27.0
1964	85.0	4.0	0.0	25.0
1965	100.0	6.0	0.0	25.0
1966	100.0	8.0	0.0	25.0
1967	100.0	8.0	0.0	22.0
1968	100.0	4.0	0.0	25.0
1969	100.0	8.0	0.0	26.0
1970	100.0	8.0	0.0	26.0
1971	122.0	10.0	0.0	12.0
1972	125.0	11.0	0.0	13.0
1973	45.0	10.0	6.0	12.0
1974	96.0	11.0	7.0	14.0
1975	62.0	21.0	13.0	7.0
1976	74.0	21.0	14.0	10.0
1977	75.0	22.0	14.0	10.0

Source: See Appendix table 17

Table 16. Rainfall (in mm's) in Saudi Arabia

Year	
1966	64.8
1967	115.3
1968	210.9
1969	94.8
1970	45.9
1971	165.3
1972	160.7
1973	58.2
1974	75.6
1975	0.0
1976	0.0
1977	0.0

Source: See Appendix table 17

Table 17. Notes on sources

All the data were not available in a suitable form in one place and some judgement had been used in selecting information.

For production and acreage: Food and Agriculture Organization Yearbook. The details are as follows:

Issue	Year of the data	Products
1963	1960	All products
1966	1961-62	Tomatoes, grapes, sesame seeds
1968	1963-65	Tomatoes, grapes, sesame seeds
1970	1966	Sesame seeds
1971	1967-69 1966-69	Sesame seeds Grapes
1972	1961-70 1970	Items not mentioned above Grapes and sesame seed
1973	1971-72	All items except tomatoes
1975	1973-74 1966-74	For all items Tomatoes
1977	1975-77	All items

For other items: Statistical abstracts for the respective countries - Various issues.