PRICE DETERMINATION IN AUSTRALIA -

A DISAGGREGATED APPROACH

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A B S T R A C T

The primary aim of this thesis is to obtain estimated sectoral price equations for Australia using quarterly data for the period 1960-61 to 1972-73. The secondary aim of the study is to use the estimated price equations obtained to make a sector by sector comparison of the determinants of sectoral prices and of the lags with which prices respond to these determinants. Aggregate price equations are also estimated and compared with the estimated sectoral price equations in order to determine whether extra information is gained by estimating separate price equations for different sectors. In the first chapter of the thesis some arguments are advanced supporting the view that a sectoral approach to the study of price determination may be necessary to obtain a better understanding of the way in which prices are determined.

Before attempting to accomplish the primary aim of this thesis two chapters are devoted to a brief review of the most important price equations studies carried out for overseas countries and for Australia - Chapter 2 contains a survey of the overseas studies and Chapter 3 contains a survey of the Australian studies. It was found that the Australian work was less extensive than the overseas work both as regards the types of disaggregation used and the types of explanatory variables tested. Chapter 3 concludes with proposals for work to be carried out in this study, these proposals consisting largely of proposals for using alternative types of disaggregation and incorporating variables which have been successfully tested overseas but not

in Australia.

The fourth chapter discusses the data available for carrying out the programme outlined in the preceding chapter. It was found that little of the required data was available and much of the data needed in the regression analysis had to be constructed from available data. As a result of this Chapter 4 contains a rather extensive discussion of the data used and the series constructed are reproduced in an appendix. The discussion of the data revealed that three different types of disaggregation could be used and since the studies reviewed gave little indication as to which type of disaggregation would be the most useful, all three types were experimented with.

The regression results for the final demand type sectors are discussed in Chapter 5, the results obtained for consumer goods sectors are discussed in Chapter 6 and the results for geographical sectors are discussed in Chapter 7. It was found that labour costs were the most important determinant of prices. Various types of labour cost variables were tried. Some were adjusted for changes in short-run productivity to form unit labour cost variables and some for changes in long-run productivity to form "normal" unit labour cost variables. It was found that the labour cost variables unadjusted for productivity (i.e., minimum wage rate and earnings variables) were the most successful. The only other variable which was consistently significant for all sectors for which it was used is the sales tax and excise variable. Materials costs were significant for some sectors only and of the many types of demand variables tried, none were consistently significant although several of the preferred equations included a demand variable.

In Chapter 8 the results for the three types of disaggregation are compared and it is argued that additional information concerning price determination in Australia is indeed obtained by using a sectoral approach. It is felt that further work in this area is warranted and that the disaggregation by final demand categories and the disaggregation by consumer categories are likely to be more useful than the geographical disaggregation. However, the difficulty of obtaining suitable sectoral data must be balanced against the advantages of using the sectoral approach to the study of price determination.

CHAPTER 1

INTRODUCTION

1.1 Introduction

The primary aim of this thesis is to obtain estimated sectoral price equations for Australia using quarterly data for the period 1960-61 to 1972-73. The secondary aim is to use these estimated price equations for the various Australian sectors to analyse questions of the following type:

(1) Do the determinants of sectoral prices differ from sector to sector?

(2) Do the determinants of sectoral prices differ from those of aggregate prices?

(3) Do the lag structures found to be most appropriate differ from sector to sector?

(4) Do the lag structures found to be most appropriate for the sectoral equations differ from the lag structure found to be most appropriate for the aggregate equation?

From the answers to question of this type we hope to throw some light on the question as to whether prices can be adequately explained by one aggregate price equation or whether it is preferable to explain sectoral prices separately, using sectoral explanatory variables in order to come to a better understanding of the process of price determination in Australia.

Since three different types of disaggregation are to be used in this study, it is hoped that the estimated sectoral price equations will also provide some indication of the type (or types) of disaggregation which ought to form the basis for further work if a disaggregated approach is, in fact, preferable to an aggregate approach.

The next section of this chapter is devoted to a discussion of the disaggregated approach to the study of price determination and the reasons why it might be used in preference to an aggregate approach. Section 1.3 will be concerned with the scope and limitations of this study.

1.2 The Sectoral Approach

While most studies of price and/or wage movements have been conducted at the aggregate level, some authors have pointed out the advantages of using a more disaggregated approach. This section will consider some of the reasons for preferring a sectoral to an aggregate approach to the question of price determination.

Firstly, it may be argued that different sectoral price levels (these will be more clearly defined later in this study) are determined by different factors. If this is the case then an aggregate approach explaining one price variable in terms of aggregate variables will, of necessity, be only a first step in the understanding of the process of price determination in the economy as a whole. Differences in sectoral price equations may be expected both on *a priori* grounds and on the grounds of empirical findings in other studies. We may expect that if different sectors have different economic structures (e.g., different industrial concentration, different types of markets, different methods of wage determination) then the behavioural equations used to explain prices in the various sectors will differ. The equations could differ in the types of explanatory variables found to be most appropriate or in the values of the parameters or both. Goodwin argues that the sectoral approach to the problem of inflation allows one to incorporate the "... structure of industry ..." into the "... analysis of inflation ..." resulting in both "... a gain in quality and quantity of information ..."[1] Bowen, after a detailed theoretical analysis of wage and price determination in the individual firm, finds that differences in the process of price determination between different sectors necessitates

> "... a less aggregative and more complex model of the general price level that recognizes the existence of various modes of price determination and the interaction of cost and demand considerations within the individual sectors." [2]

Secondly, the existence of different degrees of inflation in different sectors would seem itself sufficient to urge one to adopt a sectoral approach. Eckstein and Fromm pointed out that the inflationary experience of the United States in the period 1957-58 exhibited widely varying changes in sectoral price levels whereas the "average price level" rose by only 2-3%. They argued that this necessitated an analysis of inflation in various "key sectors" rather than an investigation of the general price level.[3]

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1. R.M. Goodwin, "A Note on the Theory of the Inflationary Process", *Economia Internazionale*, 5, January, 1952, p. 3.
2. W.G. Bowen, *The Wage-Price Issue*, (Princeton, N.J.: Princeton University Press, 1960), p. 307.
3. O. Eckstein and G. Fromm, "Steel and the Post-War Inflation" Study Paper No. 2, *Study of Employment, Growth and Price Levels*, (Washington: Joint Economic Committee, 1959).

In the case of the Australian situation, if we examine the price movements for various sectors for the post-war period, there appear to be some significant differences in the rate of price change for certain groups of goods, especially consumer goods. It appears that the trends in the price movements of different goods are sufficiently clear to warrant asking the question why these different trends occur and to attempt to answer this question using estimated sectoral price equations.

Some empirical studies have, in fact, found differences in both the determinants of different sectoral price levels and in the rates of inflation in different sectors. Some, however, have found no differences necessary in structural equations. A further discussion of the findings of price studies for both Australia and overseas countries may be found in Chapters 2 and 3 where an attempt is made to point out some of the differences found.

Thirdly, it has been strongly argued by several economists that a better understanding of the determinants of the aggregate price level may be obtained by using a sectoral approach. Goodwin has argued that with a more disaggregated approach

> "... we arrive at a basically improved vision of the *process* of inflation, i.e. the gradual transmission of inflationary impulses from market to market. In the case of inflation this is not a theoretical refinement but rather very much of its essence." [1]

Schultze also argues along much the same lines and is of the opinion that

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1. Goodwin, *op.cit.*, p.3.

> "... creeping inflation can only be understood when one goes beneath the aggregates." [1]

He argues that simply comparing ex post aggregates is not only dangerous in that

> "... they may simply illustrate tautological identities ..."

but also,

> "... because they are aggregate, they may hide the basic forces operating during the period." [2]

In a discussion of the feasibility of distinguishing cost-induced from demand-induced inflation, Samuelson and Solow are also

> "... driven to the belief that aggregate data, recording ex post details of completed transactions may in most circumstances be quite insufficient. It may be necessary first to disaggregate." [3]

Finally, it may be argued that sectoral analysis will, in some circumstances, have significant implications for economic policy actions designed to control price movements. The need to go beneath the aggregates for meaningful policy decisions appears to have strongly influenced the Joint Economic Committee price studies of 1959. In one of them Eckstein and Fromm pointed out that there were substantial differences in the percentage changes in the prices of various components of GNP in the period 1953-58 and they state that

> "... in an inflation of this sort, concentrated in a few sectors, with the average price level of the economy rising only 2 or 3 percent a year,

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1. C.L. Schultze, "Recent Inflation in the United States", Study Paper No. 1, *Study of Employment, Growth and Price Levels, op.cit.*, p. 17.
2. *Ibid.*, p. 19.
3. P.A. Samuelson and R.M. Solow, "Analytical Aspects of Anti-Inflation Policy", *American Economic Review (Papers and Proceedings)*, 50, May 1960, p. 182.

> it is particularly difficult to devise proper policies. Where excessive total demand is pulling the entire price structure of an economy upward, policy must clearly seek to bring demand down to the levels matching total supply. But where the imbalances between demand and supply in various markets are uneven and ambiguous, it becomes extremely difficult to wring the inflation out of the system without serious side-effects on the level of employment and the rate of growth." [1]

If the possibility is accepted that aggregate price movements are not necessarily caused by changes in aggregate variables but may be caused by changes in aggregate quantities being unevenly distributed amongst various sectors, then in many cases policies designed to control only the aggregate quantities with no references to sectoral imbalances will fall too heavily on certain sectors and not heavily enough on others.

This discussion may prompt the question as to why aggregate models are then so widely used. One reason is, of course, the relative simplicity of the aggregate model both with respect to its analysis and with respect to its data requirements. Bodkin also argues that in some situations

> "... the argument running in terms of macro-variables provides an insight close enough for all practical purposes."[2]

1.3 Limitations and Scope

The limitations of this thesis are of two main kinds. Firstly, the empirical work to be discussed in Chapters 5, 6 and 7 was limited by the fact that all reasonable combinations of variables and lags

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1. Eckstein and Fromm, *op.cit.*, p.3.
2. R.G. Bodkin, *The Wage-Price-Productivity Nexus*, (Philadelphia: University of Philadephia Press, 1966), p. 231.

could not be experimented with. To keep the volume of empirical work to mangeable proportions some limitations were placed on the extent of experimentation. These will be discussed in Chapter 5. In this sense, the results obtained in this study will not be conclusive but it is felt that sufficient equations were estimated to make this only a minor limitation of the thesis. A more important limitation was imposed on the study firstly by the unavailability of certain data and secondly by the doubtful quality of some of the series constructed. Because of this and because of the considerable number of series constructed, the chapter devoted to a discussion of the data used in the empirical analysis is fairly extensive. It is hoped that this rather lengthy discussion of the data will enable the reader to appreciate the limitations placed on the empirical work and the caution with which the results ought to be interpreted.

The structure of the remainder of this thesis is as follows. Chapters 2 and 3 contain a review of the most important overseas and Australian empirical price equation studies which use a disaggregated approach. Chapter 2 contains the review of the overseas studies and Chapter 3 of the Australian studies. Chapter 3 concludes by drawing together the ideas of the studies reviewed in these two chapters which it is felt ought to be tested in this thesis. As mentioned above, Chapter 4 contains a discussion of the data needed to carry out the programme outlined in Chapter 3 and the data which are available or which could be constructed from available data. The next three chapters are given over to an analysis of the regression results; Chapter 5 discusses those obtained using a demand category disaggregation and Chapter 6 those obtained using a consumer category disaggregation and Chapter 7 those obtained using a geographical disaggregation. The concluding chapter, Chapter 8, compares the results discussed in the previous three chapters and attempts to answer the questions posed in the first section of this chapter.

CHAPTER 2

OVERSEAS SECTORAL PRICE STUDIES

2.1 Introduction

In this chapter we will look at overseas sectoral price studies to see which ideas that have been used in overseas studies ought to be experimented with using Australian data. The next chapter will examine Australian studies of sectoral price determination with the aim of determining which ideas have already been tested for Australia and the success with which they have been used. Chapter 3 will also contain a section outlining the proposals for testing in later chapters.

It will be recalled that in Chapter 1 the main aim of this thesis was stated to be the estimation of sectoral price equations for Australia and, with the help of these estimated price equations, the answering of questions posed in that chapter. Thus in this chapter we are looking for studies containing sectoral price equations. Nevertheless, in the next section of this chapter we shall discuss some early work which embodies a sectoral approach to inflation while not being specifically concerned with estimating sectoral price equations. It is felt that a brief survey of these studies may be worthwhile because of possible insights that will be of use in later parts of this thesis.

The preliminary studies to be dealt with in the next section include the one by Moulton, and the four Joint Economic Committee studies for 1959 by Schultze, Eckstein and Fromm, Wilson, and Levinson.[1] As far as possible, the studies to be considered in section 2 of this chapter will be discussed according to the type of disaggregation used, the types of variables (both dependent and explanatory) used, the type of lag structure and any special features of the studies.

2.2. Early Work

2.2.1 Moulton

Moulton in his 1958 study of inflation (particularly war-time inflation) argues strongly against two prevailing aggregate views on the origins and causes of inflation. He contends that neither government deficit spending nor a rapid expansion of the money supply were responsible for the World War I inflation and tends to favour less aggregate theories. With this in mind he examines four indexes:

(a) the index of wholesale prices of all commodities,

(b) the index of wholesale prices of sensitive basic commodities,

(c) the cost-of-living index, and

(d) the index of weekly earnings in manufacturing.

He observes that, as expected, prices of sensitive basic materials rose

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1. H.G. Moulton, *Can Inflation be Controlled?* (Washington: Anderson Kramer, 1958); C.L. Schultze, "Recent Inflation in the United States", Study Paper No. 1 in *Study of Employment, Growth and Price Levels,* (Washington: Joint Economic Committee, of the U.S. Congress, 1959); O. Eckstein and G. Fromm, "Steel and the Post-War Inflation" Study Paper No. 2, *ibid.*; T.A.Wilson, "An Analysis of the Inflation of Machinery Prices", Study Paper No. 3, *ibid.*; and H.M. Levinson, "Postwar Movements of Prices and Wages in Manufacturing", Study Paper, No. 21, *ibid.*

by far the most, followed by wholesale prices, then wages and finally the cost-of-living index. He also observes that all prices rose, not only the prices of war-related goods and that this was the

> "... inevitable outcome of interactions between prices and costs in the complex financial system." [1]

His observations of the World War II experience strengthens his conclusions that

> "the price rise typically begins in the war materials and other commodities of impending shortage, and gradually extends, though in varying degree, to all commodities. Involved in this interacting process are rising costs of materials and foodstuffs, rising wages and rising costs of finished products, both civilian and military. The continuing round of cost and price advances proceeds irrespective of the character of the monetary system or of the methods of financing employed; and it proceeds whether there is a budget deficit or a budget surplus. Experience has taught that the progressive rise in prices could be checked only by stabilising wage rates and raw materials prices - the two primary elements of costs." [2]

Thus at least for wartime experience, Moulton suggests a disaggregation of the U.S. economy according to stage of production postulating that wages and raw materials costs are the most sensitive to the pressure of demand and that the resulting price increases are passed on, although not necessarily completely, in the following stages of production.

2.2.2 <u>The Joint Economic Committee Studies</u>

Now consider the four JEC studies mentioned above, all of

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1. Moulton, *op.cit.*, p. 124.
2. *Ibid.*, p. 152.

the economy by breaking up GNP into 16 expenditure categories or, in his terminology, "commodity groups". He finds strong correlation between increases in expenditure (a proxy for the pressure of demand) and price increases. But whereas expenditure fell in some sectors, prices rose in all sectors. Specifically, the investment goods sector showed the greatest increase in demand and also the greatest price increases, but sectors with no excess demand and even some with deficient demand did not show stable prices or price decreases. He also uses a second type of disaggregation in terms of the Wholesale Price Index (WPI) which

> "... is broken down by economic sectors rather than by commodity groups." [1]

He finds that industrial prices rose considerably while output was relatively stable. When he groups these industrial sectors according to stage of production he finds distinct evidence of price rigidities and further, that these rigidities are stronger the more advanced the stage of production. He explains this by saying that

> "... in general the more advanced the stage of fabrication of a commodity, the more likely it is to be cost-determined. The closer it is to a raw material, the greater will be the influence of demand." [2]

Note that this is very similar to the ideas of Moulton described above. But unlike Moulton who found that (war-induced) increasing raw materials costs were passed on along the production stages, Schultze found that raw materials costs were relatively stable and that finished goods prices generally rose because of

> "... cost increases arising out of excess

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1. *Ibid.*, p. 106.
2 *Ibid.*, p. 107.

which were concerned with the inflationary experience in the U.S. in the period 1955-58. Let us begin with the paper by Schultze. According to Schultze the period 1955-58 was characterised by generally rising prices despite the absence of aggregate excess demand. Moreover, while most prices were rising, price rises in certain sectors of the economy were greater than average. Schultze has been one of the main proponents of a disaggregated study of inflation and, in fact, his demand shift hypothesis of the inflationary process depends on this type of approach. While his analysis covers more than price determination, it is this aspect of his paper that will be considered here. He asserts that up to 1959 most analysis of inflation had been in aggregate terms but that this type of analysis was not wholly satisfactory for the 1955-57 period since this period was characterised by a marked shift in the composition of demand. The aggregate theory,he states, is based partly on the assumption that prices

> "... must be roughly as flexible in a downward direction [as in an upward direction] ... otherwise the prevention of excess aggregate demand will not guarantee price stability if the composition of demand is shifting rapidly."[1]

Against this Schultze argues that

> "as a general proposition it takes a fairly sizeable decrease in demand, lasting over a significant period to induce price cuts."[2]

Thus, it is necessary to look at the prices of individual sectors separately in relation to specific sectoral excess demands.

To examine evidence at a sectoral level he first disaggregates

1. Schultze, *op.cit.*, p. 45.
2. *Ibid.*

> demands in the investment goods industries" [1]

which gave rise to price rises in semi-fabricated goods and hence to final goods prices. Consistent with this he notes that increases in final goods prices were larger in

> "... producers durable equipment and nonresidential construction"

and that

> "... prices of finished consumer durable and nondurable goods rose by a much smaller amount, and most of the rise in consumer durable prices was accounted for by automobile prices." [2]

The Eckstein and Fromm study for the JEC is also based on the conviction that the 1955-58 creeping inflationary period cannot be satisfactorily explained by an aggregate theory and that special attention must be given to certain sectors where prices rose faster than average and to the effects of the price rises in these sectors on the rest of the economy. The steel industry was chosen as the subject for particular investigation because the rise in steel prices was significantly above average[3] and because of the strategic position of steel in the economy, steel being an important input into many other sectors. The object of the study was to examine the indirect as well as the direct effect of steel price rises on the WPI. While wages are also an important factor in the influence of the steel sector on the whole economy, the study is concerned almost entirely with the effects of changes in steel prices on the prices of the

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1. *Ibid.*, p. 108.
2. *Ibid.*, p. 107.
3. While Iron and Steel account for only 8% of the WPI, it directly accounted for 27% of the increase in the index for the period.

output of other sectors. In this context the authors of the study set themselves two main tasks: (a) to measure the extent of cost-push from steel, and (b) to analyse the factors causing the rises in steel prices.

Eckstein and Fromm use the input-output model (and thus an industrial disaggregation) to tackle the first task. Input-output analysis is used to calculate the increase that would have occurred in the WPI in the post war period if the price of steel had behaved in the same way as the average of all other prices in the WPI and this hypothetical increase in the WPI is then compared with the actual increase. To compute the movement of the index that would have occurred if steel had behaved like the rest of the index the n sectoral prices are assumed to be determined by the following input-output based static equation:

$$(2.1) \qquad p_j = a_{1j}p_1 + a_{2j}p_2 + \ldots + a_{nj}p_n + R_j, \qquad j = 1, \ldots, n$$

where p_j = price of output of sector j,

a_{ij} = input of industry i per unit output of sector j,

R_j = (value-added per unit of output of sector j) + (steel cost per unit of output of sector j).

Then R_j is written as :

$$(2.2) \qquad R_j = a_{sj}p_s + a_{kj}w_j + \pi_j , \qquad j = 1, \ldots, n.$$

where a_{sj} = unit input of steel per unit output of sector j,

a_{kj} = labour input per unit output of sector j,

p_s = price of steel,

w_j = wage rate for sector j, and

π_j = unit profit for sector j.

Hence, (2.1) can be written as:

$$(2.3) \quad p_j = a_{1j}p_1 + a_{2j}p_2 + \ldots + a_{nj}p_n + a_{sj}p_s + a_{kj}w_j + \pi_j, \quad j = 1, \ldots, n.$$

It should be noted that equations (2.3) are not price determination equations as envisaged in this study - they are more a statement of the composition of the unit revenue of the various sectors. Recognizing this, Eckstein and Fromm state that

> "... as a year-by-year estimate of the influence of steel prices on other prices, the errors are probably substantial ... but over a period of 5 or 10 years ... prices must move roughly with costs".[1]

Having calculated the increase in the WPI that would have occurred if the price of steel (assumed exogenous) had moved like the rest of the index and compared this with the actual increase Eckstein and Fromm conclude that

> "... if steel had behaved like the rest of the index, the total rise from 1947 to 1958 would have been 14 points instead of the actual increase of 23 points, that is, the extraordinary behaviour of steel accounted for 40% of the rise over the 11 years. Most of the divergence has occurred since 1951." [2]

Turning now to the part (b) of the study, which was concerned with the main causes of the observed rise in steel prices, Eckstein and Fromm found firstly, that wage costs rose much faster in the steel sector than in other sectors; secondly, that while wages were increasing sharply, profit margins were being maintained if not increased;

1. Eckstein and Fromm, *op.cit.*, p.38.
2. *Ibid.*, pp. 7, 8.

and thirdly, that while demand was not strong enough to "explain" the price rises it was sufficiently strong

> "... to permit these increases to occur without immediate and telling decline in the demand for steel." [1]

Wilson's study of the U.S. machinery sector resembled that of Eckstein and Fromm in adopting a sectoral approach to inflation and in being concerned with a specific industry. The study has two main aims:

(a) to investigate whether demand pressures were responsible for the large rises in machinery prices in the 1955-58 period, and

(b) to analyse the effects of the machinery price rises on the general price level.

To examine the first question Wilson analyses various time series for the machinery sector. These series include wage costs, material costs, plant and equipment expenditures, capital appropriations, overtime hours worked, capacity and output relative to peak and, finally, orders data. An examination of these series provides some support for the hypothesis that the inflation in the machinery sector was caused by strong demand in that sector. In addition, Wilson estimates various equations explaining the change in machinery prices. For comparison, similar equations are also estimated for the steel sector. The preferred equation arising from the regression analysis was of the form:

$$(2.4)\quad \Delta P_t = f\left[\left(\frac{NO - S}{P}\right)_{t-1}, \left(\frac{GNP - GNP^*}{GNP^*}\right)_t, \left(\frac{UFO}{S}\right)_{t-1}, \Delta W_t\right]$$

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1. *Ibid.*, p.34.

where f is linear and

ΔP = the change in price,

NO = new orders,

S = sales,

GNP* = trend GNP,

UFO = unfilled orders, and

W = wages.

The equations were fitted by Least Squares using data for the period III 1953 to II 1959. Beta coefficients were used to compare the importance of the variables in the regressions. The results of the regression analysis support the hypothesis that excess demand was an important causal factor in the price rises observed in the machinery sector. The variable (NO-S)/P (representing excess demand) was found to be significant for the machinery sector but not for the steel sector. The coefficient of (GNP-GNP*)/GNP*, reflecting the level of business activity, was found to be significantly positive for both sectors. While the estimated coefficient of the wage change variable was found to be significant and positive for both sectors, the relationship was found to be stronger in the case of steel. The variable UFO/S was not significant for either sector.

The second aspect of Wilson's study of the machinery sector is concerned with determining the effect of the greater than average increases in machinery prices on the general price level. Wilson distinguishes between direct and indirect effects. Measuring the direct effect by

$$\frac{\text{change in the index (actual) - change in the index (excluding machinery)}}{\text{change in the index (actual)}}$$

he finds that for the period 1954-58

> "...nearly one-fifth of the recent inflation in the industrial wholesale price index, and over one-fifth of the inflation in the wholesale price index for finished industrial goods are due to the greater than average price rise in machinery." [1]

Partly because of the unavailability of suitable data, he is unable to quantify the indirect effects.

Hence, while Wilson has not presented a sectoral study of price determination for the entire U.S. economy, he has presented an analysis of one important industrial sector, and has also provided estimated price equations using sectoral explanatory variables with some success for two sectors.

Finally, consider the fourth JEC study by Levinson. Levinson does not set out to test any specific hypothesis but rather to present an analysis of price and wage data for the pre-1959 period. He considers only manufacturing industries and disaggregates them according to the Standard Industrial Classification, considering 19 2-digit manufacturing industries. His study consists mainly of cross-section regression analysis of wage and price changes on employment, productivity, output, profits and concentration ratios. In the analysis no strong relationship between price change and productivity or concentration ratios was found. The strongest relationships were found to be between price changes and profit levels and, particularly after 1951-52, between price changes and changes in gross hourly earnings.

Levinson's analysis is also concerned with the examination of trends within specific manufacturing industries. The main tool

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1. Wilson, *op.cit.*, p.56.

for this analysis are the ratios of various indexes for an individual industry to the same index for manufacturing as a whole. This analysis shows significant differences between industries. Common trends were found among some industries when classified according to concentration and degree of unionisation.

To sum up, these preliminary studies have shown that a sectoral approach to the study of price determination may well be fruitful - in many cases differences between sectors in price determination methods appear to warrant the use of this type of analysis. While price determination equations were not usually presented, the studies do give some indication of the types of disaggregation and the types of variables which may be useful. We will now consider other overseas studies which, unlike those just considered, have been concerned specifically with the estimation of disaggregated price equations.

2.3 Price Equation Studies

2.3.1 Neild[1]

We will consider here only that part of Neild's study dealing with price determination. Here his major objective is to estimate an equation explaining the prices of manufacturing goods (excluding food, drink, and tobacco) in terms of wage and materials costs using quarterly British data for the periods 1950-60 and 1953-60 (the latter sample period being used to exclude the effects of the Korean War). The statistically "best" equation for 1950-60 was found to be:

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1. R.R. Neild, *Pricing and Employment in the Trade Cycle*, National Institute of Economic and Social Research, Occasional Paper No. 21 (Cambridge: Cambridge University Press, 1963).

$$(2.5) \quad p_t = 0.044 + \underset{(0.025)}{0.141} \frac{w_t}{(1.025)^t} + \underset{(0.014)}{0.106}\, m_t + \underset{(0.021)}{0.065}\, m_{t-1}$$

$$- \underset{(0.019)}{0.037}\, m_{t-2} + \underset{(0.048)}{0.603}\, p_{t-1}, \qquad R^2 = 0.998$$

where p = index of manufacturing prices (excluding food, drink and tobacco),

w = index of wage rates,

$w/(1.025)^t$ = index of wage rates adjusted for the long-term growth in the index of labour productivity estimated at 2½% p.a., and

m = index of material costs.

Results for the 1953-60 period were similar except that the coefficient of m_t was less well determined. In an attempt to remove the serial correlation evident in the above equation, a demand variable was included but it proved to be insignificant.

Separate equations for five industries (Paper, Chemicals, Timber, Textiles, and Food) were also estimated using revised data for the period 1957-61. Thus Neild's disaggregated analysis does not consist of disaggregating the economy or even the manufacturing sector into industries. Rather, the results of the analysis of the aggregate case are used to estimate equations for the five separate industries. Equation (2.5) with two changes are estimated for all five industries. Firstly, the productivity trend is "internally estimated" rather than being put in advance at 2½% per annum as in equation (2.5). Thus the variable $w_t/(1.025)^t$ is replaced by $w/(1+q)^t \simeq w(1-qt) = w - q(wt)$ and both w and wt are included as explanatory variables, the estimated coefficient of wt providing an estimate of q. Secondly, m_{t-2} is dropped in the equations for the separate industries. The dependent variable used in all equations is the industrial price for the particular sector and the explanatory variables are all "sectoral" ones, i.e., they pertain to the sector for which the equation is being estimated. As suggested by the form of (2.5), it is assumed that prices and wages are related by a geometrically declining distributed lag and that materials costs are related to prices by a distributed lag the weights of which decline geometrically from the third weight onwards. The average lags implicit in the estimated coefficients of the lagged dependent variable vary from sector to sector. The lowest average lag of 0.136 quarters was for the Timber sector and the highest of 2.135 quarters was for Food.

The variables in the individual industry equations were often insignificantly different from zero. Thus the wage rate has a significant coefficient in only two of the five equations and in one of these it enters with a negative sign. Similarly, the "internally estimated" productivity factor, q, (the coefficient of wt) is significant in only two cases (at 10%), in one of which it is negative and the other positive. The results for materials costs are somewhat better: current materials costs are always highly significant except in the Chemicals equation where it is significant at the 10% level only; but lagged materials costs are significant in only one case (Food) where it has a negative sign.

Comparing the results for all manufacturing with those for the five individual industries, Neild concludes that

> "... in contrast to the results for all manufacturing, the coefficient of labour cost [in the individual industry equations]

> is poorly determined compared with that of materials prices. As might be expected the materials prices for individual industries are more variable than for total manufacturing and also contribute more to the variations in final prices." [1]

2.3.2 Schultze and Tryon[2]

Schultze and Tryon are mainly concerned with estimating a wage-price subsystem for the Brookings model. In contrast with the two Australian studies to be discussed in the next chapter, industrial disaggregation is used rather than disaggregation by final demand category and the SIC categories are later converted by Fisher, Klein and Shinkai[3] to conform with the final demand categories of the other parts of the model. Disaggregation is by industry because

> "... the basic data and decision-making framework in the area of costs, factor prices, and demand for factors, relate primarily to an industry structure." [4]

The price subsystem for the model consists of price equations for the following industrial sectors:

(a) Durable manufacturing,

(b) Nondurable manufacturing plus mining of crude petroleum and natural gas,

(c) Wholesale and retail trade,

(d) Regulated industries,

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1. *Ibid.*, pp. 24, 26.
2. C.L. Schultze and J.L. Tryon, "Prices and Costs in Manufacturing Industries", Ch. 9 in J.S. Duesenberry *et al.*, *The Brookings Quarterly Econometric Model of the Unites States*, (Chicago: Rand McNally, 1965).
3. F.M. Fisher, L.R. Klein and Y. Shinkai, "Price and Output Aggregation in the Brookings Econometric Model", Ch. 17, in Duesenberry, *op.cit.*
4. Schultze and Tryon, *op.cit.*, p. 283.

(e) Contract construction, and

(f) Residual industries.

Separate equations are also estimated later for most of the SIC 2-digit industries, but this, obviously, was not the main part of the study.[1]

Generally wholesale price levels, where available, were used as dependent variables. In some cases value-added prices were used and for the contract construction industry an implicit deflator was used. Regression equations were also reported using first differences one quarter apart as the dependent variable but the equations incorporated into the model were all of the price level type. Most of the equations for the 2-digit industries used WPI levels as the dependent variable.

All explanatory variables used were sectoral ones and were chosen on the basis of the following three-part pricing hypothesis:

(i) Prices are largely determined by markup on standard costs, i.e., costs at some "normal" level of operations,

(ii) Short-run cost changes have some effect on prices but this effect is smaller than that of standard cost changes.

(iii) Markup is influenced by demand relative to supply.

In addition Schultze and Tryon test whether the response of prices to positive and negative excess demand is asymmetrical.

For standard costs the variable used is:

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1. Schultze and Tryon point out that "... a number of industries are missing, and only a few of the possible combinations of variables were tried." (*ibid.*, p. 310)

$$ULCN = \frac{RWSS}{\bar{X}}$$

where ULCN = normal (or standard) unit labour costs,

RWSS = compensation per manhour, and

$\bar{X}$ = a 12-term moving average of output per manhour.

except in the equations for the regulated industries where the trend value of depreciation per unit of output was used. This variable was not used in most other cases because of the difficulty of obtaining meaningful and accurate data. To represent raw materials costs at normal capacity a 4-quarter moving average of the materials price index was used.

To test whether prices reacted to short-run fluctuations of actual unit labour costs (ULC) about standard unit labour costs the variable (ULC - ULCN) was also included in the regression equations. To test the validity of part (iii) of the pricing hypothesis (i.e., the effect of demand pressure onmarkup) the following variables were experimented with:

(a) A capacity utilisation index used in the form of deviations from trend.

(b) In some cases the deviations of capacity utilisation from trend of the supplying industries,

(c) Deviations from trend of the ratio of inventories to output.

Finally, to test the asymmetry hypothesis the deviations of the capacity utilisation index were split up into positive and negative deviations and entered into the equations as two separate variables. A finding that the estimated coefficients of these two variables were significantly different would support the hypothesis.

Having considered the structure of the equations experimented with let us turn to the results. First consider the estimation results for the six industry groups. As noted previously, different dependent variables were used for these groups. For durable and non-durable manufacturing the WPI for these two groups is used, for contract construction an implicit deflator is used and for the remaining three groups the dependent variable is a value-added price. Hence, for these last three groups materials prices are not relevant as an explanatory variable and therefore a comparison of materials prices vis-a-vis, say, ULCN cannot be made. Comparing the results for durable manufacturing, nondurables manufacturing, and contract construction, we find that in all equations ULCN is the most important variable (being consistently highly significant both in level and first difference equations). In the durables case the deviation of ULCN from ULC is found to be only marginally significant while in the nondurable equation it usually has the wrong sign and is insignificant. For construction this variable is significant but with a smaller coefficient than in the durables case (this is so in both the level and first difference form of the equations). Looking at materials costs, they were found to

> "explain a substantial part of the variance not accounted for by normal unit labour costs." [1]

In the price level equations reported materials costs were insignificant (and generally of the wrong sign) in the durables case and

1. *Ibid.*, p. 305.

generally significant for the nondurables and the construction sectors. Where the equations were in the first difference form, results with the materials costs variables were similar for nondurables and construction and improved for the durables sector, the estimated coefficient usually being significantly positive. For the groups for which value-added prices were used the most important variable was ULCN although in the trade sector the coefficient of (ULC-ULCN) was not consistently smaller than the coefficient of ULCN. The variable for depreciation costs added to the regulated industries equations was found to be significant. In the residual industries (ULC - ULCN) and ULCN were again found to be of equal importance.

The results of experimentation with demand variables were very mixed. Generally, Schultze and Tryon found the performance of the capacity utilisation variable disappointing and they remark that this may well be the result of the poor data used to measure this variable. It did prove to be significant in some cases but, on the whole, the ratio of inventories to output proved significant in more cases. In most cases it was found that where capacity utilisation appeared to have some effect on prices, positive deviations had a larger coefficient than the negative deviations, thus providing some support for the asymmetry hypothesis.

Turn now to the estimated equations for the SIC 2-digit industries. These equations were not as fully experimented with as were the equations for the six industry groups discussed above. ULCN or a variable combining ULCN and depreciation costs is again the most consistently significant. As might have been expected, materials prices proved to be more important in the equations for some of the 2-digit industries than in the equations for the six groups discussed above. The problem of multi-collinearity between materials and labour costs was encountered in many of the equations making the parameter estimates somewhat unreliable. There appeared to be weak evidence of the asymmetrical effect of demand on prices.

Sophisticated distributed lags were not used by Schultze and Tryon. However, various combinations of short lags were experimented with. Unlagged variables were almost always used in preferred forms since

> "... the regressions obtained [using lagged variables] had poorer fits than the unlagged versions, and, almost without exception, the standard errors of the regression coefficients were larger." [1]

2.3.3 Eckstein and Fromm[2]

The main purpose of this study by Eckstein and Fromm is to test the validity of two competing pricing hypothesis:

(a) the competitive hypothesis, and

(b) the full-cost or target-return hypothesis.

For this purpose they estimate equations for the U.S. manufacturing sector as a whole and disaggregating this sector along industry lines, they also estimate separate equations for the durables and nondurables sectors. Wholesale prices in three different forms (the price level, the first difference in the price level, and the percentage change in the price level) were used to represent the dependent variable. As in other studies, equations with the dependent variable in the

1. *Ibid.*, p. 307.

2. O. Eckstein and G. Fromm, "The Price Equation", *American Economic Review*, 58, December 1968, pp. 1159-1183.

first difference form had lower $\bar{R}^2$'s than the price level equations. The $\bar{R}^2$'s associated with the equations having the dependent variable in percentage change form generally fall in between.

Eckstein and Fromm argue that the competitive hypothesis suggests that the following explanatory variables should be used:

(a) the backlog of unfilled orders - both level and change,

(b) the deviation of inventories from their optimal level,

(c) changes in unit labour costs,

(d) changes in unit materials costs, and

(e) the industry operating rate.

On the other hand, they argue that the target-return hypothesis suggests the following explanatory variables:

(a) changes in standard unit labour costs,

(b) changes in standard unit materials costs,

(c) changes in the standard capital/output ratio, and

(d) changes in the target rates of return, standard markup or standard volume.

In addition to the above nine variables, the deviation of ULC from ULCN was used as an explanatory variable to allow for a mixture of the two methods of pricing. Finally, asymmetry of price reaction to positive and negative cost changes was tested using two different tests. Firstly, (ULC-ULCN) was split up into positive and negative deviations which were used to form two separate variables. The second test involved two steps, the first of which was to identify the quarters in which, according to the estimated price equation, prices should have fallen and then to re-estimate the equation using data for the quarters in which prices should have risen (the equation could not be re-estimated for the quarters in which prices should have fallen because there were too few observations). If the estimated coefficients for the cost variables in the re-estimated equation are larger than those in the original equation a bigger than average price reaction to cost increases is suggested. Only weak evidence for the asymmetry hypothesis was found using these tests.

The result of estimating equations with the above explanatory variables suggest that, in general, a mixture of the two competing pricing hypotheses provides the best explanation of price levels and price changes. The results for all manufacturing show that, on the basis of Beta coefficientcs, ULCN and lagged ULCN are more important than (ULC - ULCN) which is, however, significant. Materials costs are also important. Similarly, demand variables are less important than cost variables although both the operating rate and the ratio of unfilled orders to sales are significant. The estimated first difference and percentage change equations generally confirm these conclusions. When separate equations for durables and nondurables are estimated it is found that results for durables are similar to those for all manufacturing except that ULCN appears to be more important in the durables equation. In the equation for nondurables fewer variables prove to be significant but materials costs are more important. Of the demand variables, the industrial operating rate was found to be most useful.

Finally, consider the results of experimentation with lags. Some of the individual variables were introduced with one period lags, ULCN proving to be the most important. The lagged dependent variable was also tried in many equations. In the price level form of the equation for all manufacturing the coefficient of the lagged dependent variables was high and highly significant. $\bar{R}^2$ increases when this variable is introduced into the equation. But Eckstein and Fromm note that

> "... of course, it is not satisfactory to rest so much of the statistical explanation on the lagged dependent variable." [1]

Thus they consider the result of including the lagged dependent variable in the first difference form of the equation and find that it has a smaller estimated coefficient and a smaller t-ratio suggesting that the

> "... lags in the other variables ... account for most of the dynamics in the process. Thus this equation argues that prices adjust rather promptly to changes in demand and cost conditions, with the largest part of the adjustment occurring within a few months." [2]

In the first difference form of the equation for durables, the lagged dependent variables has a large coefficient but again substantially smaller than in the level form of the equation for all manufacturing.

2.3.4 Evans[3]

As with many of the other studies so far considered the work by Evans to be discussed now is concerned with estimating price equations for a macro-econometric model, in this case for the U.S. economy. His study is included because, to some extent, he uses a disaggregation into sector by stage of production although he also

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1. *Ibid.*, p. 1173.
2. *Ibid.*
3. M.K. Evans, *Macroeconomic Activity*, (New York: Harper and Row, 1969), especially Ch. 11, sections 1-3.

disaggregates by final demand sector. Both price level and price change equations are used in the same model. Evans' "basic" equation is the one explaining the level of manufacturing prices measured by the WPI. He then estimates price change equations (based largely on the change in manufacturing prices) for the following final demand sectors:

(a) consumer nondurables and services,

(b) consumer durables except autos and parts,

(c) autos and parts,

(d) fixed business investment,

(e) residential construction, and

(f) exports.

The manufacturing price equation explains the level of manufacturing prices measured by the WPI. The sectoral price equations for (a)-(f) above use implicit deflators in first difference form as the dependent variable. The preferred form[1] of the estimated equation explaining manufacturing prices has the following explanatory variables:

(i) unit labour costs - $\dfrac{\text{total wage bill for the manufacturing sector}}{\text{total ouput originating in the manufacturing sector}}$,

(ii) capacity utilisation index,

(iii) the lagged dependent variable in the form of the average level of manufacturing prices in the previous four quarters, and

(iv) a dummy variable for the Korean War.

The sectoral price change equations are explained largely by changes in manufacturing prices, this form being based on the argument that

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1. For the theory underlying the form of the equation see Evans, *op.cit.*, pp. 290-300.

> "... the prices of service industries are almost entirely determined by wage rates in these industries; the prices of trade industries are usually determined by a certain percentage markup of manufactured goods. Thus if one can explain wage rates and prices of manufactured goods, prices of service and trade sectors can be easily determined."

Thus, the three consumer goods price changes and the change in export prices are explained by the change in manufactured goods prices and the lagged change in manufacturing prices. In the equation for nondurables and services the change in farm prices is also included as an explanatory variable (a wage rate variable is not included). The equations explaining the two investment implicit deflators have a somewhat different form. The change in the implicit deflator for fixed business investment is explained by the change in the implicit deflator for GNP and the ratio of fixed business investment to GNP, the latter term being used to represent the inelasticity of fixed business investment with respect to price. The change in the residential construction deflator is explained by the change in the GNP deflator and the change over two quarters of the sum of fixed business investment and investment in residential construction.

As noted previously, the manufacturing price equation includes the lagged dependent variable among the explanatory variables. This variable is derived from an adjustment process of the form:

(2.6) $$\Delta p = \delta (p^* - p_{-1}),$$

where p^* = the equilibrium price, and

p = actual price.

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1. *Ibid.*, p. 291.

The lagged dependent variable on the right-hand-side of the equation is used in 4-quarter moving average form for statistical reasons because

> "... otherwise the parameter estimate of the lagged term is likely to be severely biased upward."

Evans warns that despite this precaution

> "... the importance of this term should not be overrated. Firms are likely to adjust prices quickly to changes in unit labour costs and capacity utilisation." [1]

As previously noted, some of the sectoral price change equations have one period lags.

2.3.5 Phipps[2]

Phipps, in his study of the effect of productivity and demand on prices in the U.K., estimates various price equations for four U.K. industries: (i) Chemicals, (ii) Textiles, (iii) Timber, and (iv) Paper. All equations estimated have the price level as the dependent variable. The explanatory variables are arrived at in the following manner:

Prices are assumed to be determined by markup over unit costs:

$$P = K_0 + K_1 C \tag{2.7}$$

where P = price of final output,

C = Unit prime costs,

and K_0, K_1 are constants.

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1. *Ibid.*, p. 297.
2. A.J. Phipps, "The Roles of Labour Productivity and Demand in the Pricing Process", *Bulletin of the Oxford University Institute of Economics and Statistics*, 31, November 1969, pp. 285-301.

Writing unit prime costs as a weighted sum of wage earnings and raw materials price (2.7) becomes:

$$(2.8) \qquad P = K_0 + K_1 (B_1 W + B_2 M)$$

where W = hourly wage earnings, and

M = raw materials price.

An equation of this form is used to test the effect of labour productivity on the prices of the four sectors by specifying B_1 in two different ways. The first form which Phipps uses is:

$$B_1 = \frac{X_t}{N_t}^{-1}$$

where X = output per week at constant prices, and

N = the number of hours worked per week.

Use of this form implies that prices are influenced by short-run productivity changes, and that the relevant labour costs variable is B_1W which is similar to the actual unit labour cost (ULC) variable used in some studies discussed earlier. The second form is similar to the one used in Neild's study and is given by

$$B_1' = \left[\left(\frac{X}{N}\right)_o \cdot \left(1 + \frac{n}{100}\right)^t\right]^{-1}$$

where $\left(\frac{X}{N}\right)_o$ = "full" capacity labour productivity in some base year, and

n = the rate of growth of labour productivity (% per six months).

Use of this form implies that prices are influenced by long-run movements in productivity trend and that the relevant labour cost variable is $B_1'W$ which can be thought of as a ULCN variable.

To test the role of demand in the pricing process a demand variable, D, for which Kuh's "demand ratchet"[1] is used, is added to the preferred estimated equation for each sector.

It is assumed that both labour costs and materials costs enter into the pricing equations with a distributed lag. To make the estimation of these lags manageable Phipps assumes that full adjustment of prices to these two costs is completed within two periods. This assumption is used in preference to a Koyck-type distribution of the lag weights because the statistical problems inherent in the estimation of geometrically declining lags are thus avoided and also because the estimation of the equations under the above assumptions shows that the lag coefficients do not always decline geometrically. The demand variable is used only in the current form.

Thus the estimated equations for each of the four sectors are of the form:

$$(2.9) \quad P_t = a_o + a_1 (B_1W)_t + a_2 (B_1W)_{t-2} + a_3M_t + a_4M_{t-1} + u_t$$

These equations are first estimated for each sector using the two alternative specifications for B_1 to test the two assumptions made about productivity. The preferred forms resulting from these regressions are then used to test the importance of demand in the pricing process, equations of the following form being estimated for each sector:

$$(2.10) \quad P_t = a_o + a_1(B_1W)_t + a_2(B_1W)_{t-2} + a_3M_t + a_4M_{t-1} + a_5D_t + u_t$$

1. E. Kuh, "Profits, Profit Markup and Productivity", Study Paper No. 15, *Study of Employment, Growth and Price Levels*, *op.cit.*

Finally, in an appendix Phipps reruns the regressions using a Koyck-type distributed lag so that he may compare his results with those obtained by Neild who also uses this type of lag.

Consider firstly, the results of the labour productivity test. Phipps notes that the choice between the competing hypotheses concerning the specification of B_1 will be made mainly on the basis of the t-statistic for the labour cost variable rather than on the basis of R^2 since

> "... we are not concerned with producing an equation which yields the best predictive estimates but with choosing between hypotheses which deal specifically with the role of labour productivity in the pricing process." [1]

The regression results showed that actual unit labour costs (B_1W) provided the best results for the Paper and Timber sectors and that $B_1'W$ was preferable for the other two sectors. Current materials prices were always significant but lagged materials prices were generally insignificant. The Durbin-Watson test for serial correlation was generally indeterminate at the 5% level. When the demand variable was included it proved to be significant at the 5% level only for the Paper sector. At the 15% level the demand variable was also significant in the Timber equation.

The results of lag estimation were mixed. Lagged materials prices tended, on the whole, to be insignificant. Lagged unit labour costs were often significant and in some cases the coefficient of lagged wage costs was greater than that for current wage costs. The results of re-estimating the equations using a Koyck-type lag

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1. Phipps, *op.cit.*, p. 289.

were markedly different from those obtained using the lags described above. As has previously been the case with price level equations, the lagged dependent variable is always highly significant and the size of the estimated coefficient varies between 0.346 and 0.657. Because of the marked difference between the results of the regression using the two different lag formulations Phipps is of the opinion that

> "... Neild's conclusions may stem from the fact that he uses a Koyck-type distributed lag which is inappropriate and/or produces biased estimates when OLS are used."[1]

2.3.6. Agarwala and Goodson[2]

As the title of this study suggests, Agarwala and Goodson are interested in consumer goods prices. Their study of consumer prices in the U.K. is policy-oriented. Specifically, they set out to analyse the effects of the Selective Employment Tax (SET) and indirect taxes on consumer prices. For this purpose they feel that a disaggregated approach is necessary.

Two types of disaggregation are used. In the first instance an industrial classification based on a 13-sector input-output table for the U.K. for 1963 is used. Prices based on this classification are later converted to prices for 10 consumer commodity groups. Their basic hypothesis is that unit prime costs and taxes are the primary factors determining prices. The input-output model is used to compute unit prime costs. Noting that unit prime costs are defined

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1. *Ibid.*, p. 296.

2. R. Agarwala and G.L. Goodson, "An Analysis of Consumer Goods Prices in an Input-Output Framework", *Oxford Economic Papers*, 22, November 1970, pp. 57-72.

as the sum of unit labour costs and unit import prices, their reason for using the input-output model is given as follows:

> "It is ... important to remember that the relevant labour (or import) cost is not just the direct cost at the final stage of production but the direct and indirect labour and import cost entering into the commodity at various stages of its production. In this situation it is virtually impossible to work out the effects of changes in particular wage rates (or import prices) on particular commodities by the usual time-series regression ... The only plausible approach is to utilize extraneous empirical information to form a hypothesis about the importance of a particular cost item in the price of a particular commodity and then see if the price movements predicted on the basis of these *a priori* constraints agree with the observed movements of prices." [1]

The "extraneous empirical information" which they find most useful for their purposes is the input-output model.

All equations are estimated with the price level as the dependent variable. As regards the explanatory variables and the lags used in the equations finally estimated consider first the derivation of the unit prime costs series using the input-output model. Unit prime costs are assumed to be related to unit labour costs and import prices in the following way:

(2.11) $$C = A.C + D.W + E.M$$

where C = a vector of unit prime costs

A = the input-output matrix,

D = a diagonal matrix showing the proportion of unit costs formed by wages,

E = a diagonal matrix showing the proportion of unit costs formed by unit import costs,

1. *Ibid.*, p. 57.

W = a vector of unit labour costs, and

M = a vector of unit import costs.

Using results obtained by Godley and Rowe[1] for the aggregate case one-period lags are introduced into this equation to get:

$$(2.12) \qquad C_t = A.C_{t-1} + D.W_{t-1} + E.M_{t-1}$$

As noted previously, the input-output matrix used (and hence the above equation) is in terms of industrial sectors but Agarwala and Goodson are interested in consumer prices. This equation is therefore converted to one in terms of consumer goods sectors by methods used by Brown and Fisher, Klein and Shinkai.[2] The equation used for conversion is:

$$(2.13) \qquad C_{ct} = R.C_t + B.M_t$$

where C_c = a vector of prime costs for consumer goods,

R = a matrix for converting industrial categories into consumer goods categories, and

B = a matrix showing the direct import content by industry of final consumer goods expenditure.

By repeated substitution of (2.12) into (2.13) the following expression is obtained:

$$(2.14) \qquad C_{ct} = BM_t + REM_{t-1} + RAEM_{t-2} + RA^2EM_{t-3} + \ldots + RDW_{t-1} + RADW_{t-2} + RA^2DW_{t-3} + \ldots$$

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1. W.A. Godley and D.A. Rowe, "Retail and Consumer Prices 1955-1963", *National Institute Economic Review*, November, 1964.pp.44-57.

2. A. Brown, "Exploring 1970: Some Numerical Results" Chapter 6 in *A Programme for Growth*, (Chapman and Hall, 1965); Fisher, Klein and Shinkai, *op.cit.*

Lags of up to eight periods were used in this expression to obtain series for unit prime costs.

Using these prime costs figures, Agarwala and Goodson propose to estimate equations of the following form for each sector i = 1, ..., 10

$$(2.15) \quad P_{it} = \alpha_1 + \beta_i C_{cit} + \delta_i D_{it} + \sigma_i T_{it} + u_{it}$$

where P_i = price of consumer good i,

C_{ci} = the elements in the unit prime cost vector obtained from (2.14),

D_i = the pressure of demand for good i,

T_i = the indirect tax on good i, and

u_i = the error term for the i^{th} equation.

Thus all explanatory variables are sectoral ones.

In their statistical analysis Argarwala and Goodson assume that indirect taxes are fully passed on to consumers and so the dependent variable in the equations actually estimated becomes price net of tax, i.e.,

$$(2.16) \quad P^e_{it} = \alpha_i + \beta_i C_{cit} + \delta_i D_{it} + u_{it}$$

is the form of the equation actually estimated. Indirect taxes are later added on to the estimated equations to obtain final prices. The regressions were run using both annual and quarterly data. The unit labour costs component incorporated into the prime cost series discussed above was used in three different forms:

(i) Current unit labour costs,

(ii) A 4-quarter moving average of unit labour costs, and

(iii) An 8-period moving average of unit labour costs.

These different forms were tried in order to test whether prices are more sensitive to short-run or long-run changes in unit labour costs. The 4-period moving average proved to be superior and is used in preferred equations and also in the quarterly estimates. The prime cost variable proved to be highly significant in all equations reported. No suitable sectoral data were available to measure the influence of demand so that the rate of growth of quantity demanded was used as a proxy in the annual equations. In the regressions it consistently had a negative sign (contrary to expectations) and significantly improved the fit of only one of the sectoral equations. It was therefore dropped from the equations in subsequent policy analysis.

In the regressions using quarterly data prime costs based on a 4-period moving average of unit labour costs was again used. Two variables were used as a measure of demand pressure : (i) the ratio of the quantity consumed in the current quarter to the quantity consumed in the same quarter a year ago, and (ii) the ratio of the quantity consumed in the current quarter to the moving average of quantities consumed in the previous four quarters. Both variables, however, were omitted from the preferred equations for reasons similar to those for dropping the demand variable from the annual equations.

As mentioned previously, one period lags were incorporated into the calculations of unit prime costs. The length of these lags was based on the aggregate study by Godley and Rowe and no other experimentation with lags is reported.

2.4 Conclusions

This chapter has surveyed some important empirical studies on sectoral price determination for overseas countries. In the discussion the studies were divided into two groups: (i) those early studies which were concerned with a sectoral approach to inflation but which did not contain rigorous statistical tests of price equations, and (ii) those studies containing statistical tests of disaggregated price equations. Different types of disaggregation were used and many types of explanatory variables were used. In the concluding section of this chapter an attempt will be made to draw together the main ideas emerging from the discussion of these studies. A more detailed discussion of which of the hypotheses suggested by these studies (which ought to be tested for Australia) will be deferred to the following chapter. As most of the explanatory variables used in these studies appear relevant to most types of disaggregation (with the possible exception of geographical disaggregation) variables will not generally be described in relation to any particular type of disaggregation.

Four different types of disaggregation have been used in the studies reviewed above. Moulton, Schultze and Evans have all used a state-of-production-type of disaggregation. Moulton and Schultze both used this type of disaggregation to show the effects of price increases spreading through the economy mainly by way of materials costs, while Evans used it in conjunction with sectors defined by final demand categories. All these studies indicate that the determinants of prices may well differ according to the stage of production.

Most of the other studies have used sectors defined by industry. One of the reasons for this is probably the availability of WPI numbers in the U.S. and industrial prices in the U.K. The study of Schultze and Tryon appears to be the only one which discusses its choice of method of disaggregation. In this case the industrial classification is used partly for reasons of data availability and also because it corresponds more closely to decision-making areas. Besides this there are two studies using input-output analysis the disaggregation in which is largely by industrial classification. Two other types of disaggregation have been used, viz., final demand categories by Schultze and by Evans and consumer goods categories by Agarwala and Goodson.

The type of dependent variable used in the studies has usually corresponded to the type of disaggregation used. Thus, when the final demand type of disaggregation has been used an implicit deflator has been the dependent variable, and when industrial disaggregation has been used industrial prices have usually been the dependent variable. Schultze and Tryon were the exception. They used an industrial disaggregation with three types of price variables: (i) industrial prices, (ii) implicit deflators, and (iii) value-added prices. The most common forms which the dependent variable has taken have been the price level and the change in the price level. Eckstein and Fromm also used percentage changes. Using variables in the level form invariably gives the highest R^2 but multi-collinearity often becomes a problem and the importance of the lagged dependent variable if used becomes suspect (see the studies by Phipps, Evans, Eckstein and Fromm). Use of the dependent variable in the first difference form brings with it possible errors of observation.

As many types of explanatory variables have been used in the various studies, it is not proposed to consider them all here, but merely to mention the ones which have proved to be the most useful. A more complete discussion is contained in Chapter 3. With little doubt the variable which has contributed most to the variation in price levels or price changes has been unit labour costs. This variable has been used in various forms and it appears that some type of normal labour cost variable has been the most useful. However, for various sectors actual unit labour cost has also been found significant (see, e.g., Phipps) and therefore this variable ought not to be rejected *a priori*. (One of the advantages of a disaggregated approach is that different types of variables can be used for different sectors where necessary.) Another cost variable frequently used especially in the more disaggregated studies is materials costs. There appears to be strong evidence that the materials-costs variable is far more likely to be significant in disaggregated than in aggregate studies although it will not necessarily be significant for all sectors. This variable has almost always been used in "actual" form rather than in "normal" form but there does not seem to be any obvious reason for this.

On the demand side, many different variables have been used most of them relating to the product market rather than to the labour market. Schultze, in his 1959 JEC study used the change in expenditure for various categories of goods to gauge the extent of excess demand in various sectors. Eckstein and Fromm in their 1959 study also used changes in output of the steel sector to measure demand but state that the rate of capacity utilization is a better indicator of demand (especially in relation to supply) and also used the backlog of orders. However, neither of the studies have tested the variables empirically in price determination equations. Wilson used two variables successfully in his equations for the machinery and steel sectors, viz., (NO - S)/P and a variable, (GNP - GNP*)/GNP*, representing the general level of business activity. Turning now to the price equation studies, we find that Neild found that an index of excess demand for the labour market was insignificant in his aggregate equations. He does not give any indication that demand variables were used in his disaggregated equations. Schultze and Tryon found that the capacity utilization index performed disappointingly, being significant in only a few cases and that the ratio of inventories to output which was used to represent demand in some cases, proved to have a stronger influence. Eckstein and Fromm in their 1968 study found the ratio of unfilled orders to sales and the industrial operating rate to be significant measures of demand. Evans experimented with various measures of demand in his manufacturing price equation but found that the capacity utilization index was the most satisfactory. Phipps examined Neild's negative conclusions on the importance of demand and feels that the use of a labour market proxy for demand in the product market is not very satisfactory and that this may have resulted in Neild's conclusion. As an alternative, Phipps uses Kuh's "demand ratchet" variable (defined previously) but finds it to be significant in only one of the four industries which he considers and marginally significant in another. Finally, Agarwala and Goodson used the rate of growth of quantity demanded without success to represent the pressure of demand.

When we consider the lag structure, we find that only one or two period lags on the individual variables or Koyck-type lags have been used in these studies. Studies using Koyck lags by the introduction of the lagged dependent variable on the right-hand-side of the equation, have generally warned against the importance of this variable especially in a price level equation (see the studies by Evans, Phipps, Eckstein and Fromm). Hence, in general, the studies indicate that short lags are the most appropriate.

Finally, various authors have tested the importance of asymmetrical price reactions to demand and cost changes. The evidence in favour of this hypothesis does not appear to be very strong but it has been found to be important in some sectors and will be worth experimenting with in Australian equations.

CHAPTER 3

SECTORAL PRICE STUDIES FOR AUSTRALIA

3.1 Introduction

Having examined sectoral price studies carried out using data for overseas countries in the previous chapter, let us now turn to the Australian work which has been done in this area. We find only two important studies both of which are concerned with estimating disaggregated (in the second case only slightly disaggregated) price equations for incorporation into macro-econometric models of the Australian economy. First the price equations for the Reserve Bank of Australia (RBA) model will be considered and then we will look at the price equations for the Treasury - Australian Bureau of Statistics (T-ABS) model.

3.2 Survey

3.2.1 The RBA Equations

The published material on the RBA equations consists of two papers.[1] Paper 3F, which will be considered first, briefly describes the theoretical basis of the equations and some experimentation carried out with alternative forms. Paper 3G contains later versions

1. W.E. Norton, K.E. Schott, and K.M. Sweeney, "Price Equations", in W.E. Norton, K.E. Schott, and K.M. Sweeney, *Employment and Prices*, Occasional Paper 3F, (Sydney: Reserve Bank of Australia, 1971). W.E. Norton and J.F. Henderson, *A Model of the Australian Economy: A Further Report*, Occasional Paper 3G, (Sydney: Reserve Bank of Australia, 1972).

of the preferred estimated equations as included in the model RBA1. The two papers will be considered separately because of some differences in the equations estimated and in the variables used. Both papers are, however, concerned with estimating price level equations for various sectors for the purpose of incorporation into the Bank's macro-econometric model. Apart from data restrictions this is probably the main reason for the use of sectors defined by categories of final demand and implicit deflators to measure the various price levels.

Firstly, consider Occasional Paper 3F. The authors of this paper attempt to construct price equations which include both cost and demand influences on prices. They find that price theory suggests the following type of equation for the equilibrium price level:

$$p^* = f(X, ULC, pim, R), \tag{3.1}$$

where p^* = the equilibrium price level,

X = the pressure of demand,

ULC = unit labour cost,

pim = import prices, and

R = the rate of sales tax.

Following a suggestion by Eckstein and Fromm[1] that in the oligopoly case prices are influenced not by short-run productivity changes as reflected in actual unit labour cost but by long-run productivity changes as reflected in a "normal" unit labour cost variable (ULCN), ULC is replaced by ULCN. Equation (3.1) then becomes:

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1. O. Eckstein and G. Fromm, "The Price Equation", *American Economic Review*, 58, December 1968, 1159-1183.

$$(3.2) \qquad p^* = f(X, ULCN, pim, R).$$

Eckstein and Fromm's method[1] is used to calculate the ULCN series. To cast the equation in terms of actual rather than equilibrium prices, it is postulated that these two variables are related by the following distributed lag:

$$(3.3) \qquad P_t = w_0 P^*_t + w_1 p^*_{t-1} + \dots\dots\dots\dots + w_k p^*_{t-k},$$

where k is some positive integer. Assuming that for $k = \infty$ the coefficients $w_0, \dots, w_k$ in this equation have been generated by a general Pascal probability distribution, a result by Jorgenson[2] may be used to write equation (3.3) as:

$$(3.4) \qquad V(L)p_t = U(L)p^*_t$$

where U(L) and V(L) are polynomials in the lag operator, L, of degree m and n respectively. Experimentation with various cases of U(L) and V(L) showed that because of statistical problems[3], they could be of no greater order than zero and one respectively. Hence, equations (3.1) and (3.2) become:

$$(3.5) \qquad v_0 p_t + v_1 p_{t-1} = u_0 f(X_t, ULC_t, pim_t, R_t).$$

$$(3.6) \qquad v_0 p_t + v_1 p_{t-1} = u_0 f(X_t, ULCN_t, pim_t, R_t).$$

These equations are estimated in the form:

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1. *Ibid.*, pp. 1168-1169.
2. D.W. Jorgenson, "Rational Distributed Lags", *Econometrica*, 32, January, 1966, pp. 135-149.
3. The dependent and explanatory variables showed autocorrelation and there was evidence of collinearity between them.

$$(3.5') \qquad p_t = g(X_t, ULC_t, pim_t, R_t) + v_0' p_{t-1} ,$$

$$(3.6') \qquad p_t = g(X_t, ULCN_t, pim_t, R_t) + v_0' \, p_{t-1}$$

where $g(\underline{x}) = (u_0/v_0)f(\underline{x})$, $\underline{x}$ some vector of explanatory variables,

and $v_0' = -v_1/v_0$

These equations are estimated for the following implicit deflators:

(a) the implicit deflator for GNE,

(b) the implicit deflator for personal consumption expenditure on purchases of motor vehicles,

(c) the implicit deflator for personal consumption expenditure on other durables,

(d) the implicit deflator for personal consumption expenditure on non-durables,

(e) the implicit deflator for private investment in dwellings,

(f) the implicit deflator for private investment in equipment,

(g) the implicit deflator for private investment in construction.

Before discussing the estimated equations it should be noted that mainly aggregate explanatory variables are used. The exception is the sales tax rate and, of course, the lagged dependent variable. As regards the explanatory variables the following points should be noted. First, since direct measures of demand pressure in the product market in Australia are not readily available, labour market proxies were used in the empirical analysis. Both total unemployment and total vacancies were experimented with separately and with the exception of the equation for consumer durables, these variables were also used with one period lags. Secondly, to represent unit labour costs the following different variables were used in the reported estimated equations:

(i) Current unit labour costs = $\frac{\text{wages, salaries and supplements}}{\text{non-farm GNP at constant prices}}$,

(ii) normal unit labour costs calculated using Eckstein and Fromm's method as noted above, and

(iii) average weekly earnings.

Further, again following Eckstein and Fromm, the variable (ULC-ULCN) was used as well as ULCN

> "... so as to allow for a mix of competitive and oligopolistic influences." [1]

Thirdly, for import prices the implicit deflator for imports of goods and services was used. This variable was used only in the GNE equation. Fourthly, for the two consumer durables equations (motor vehicles and other durables) the appropriate percentage rate of sales tax was used.

In the equation for (a) (the implicit deflator for GNE) ULCN was found to be far superior to ULC (in terms of the significance of the estimated coefficient) but was not superior to the average earnings variable. The coefficient of the current unemployment variable was found to be significant whereas the coefficient of the same variable lagged one period was found to be insignificant. The results obtained using vacancies (both current and lagged) were similar to those using current unemployment. The import prices variables has a significant coefficient only in some cases and the coefficient of (ULC - ULCN) is highly insignificant.

In the equations for (b), (c) and (d) explaining the implicit

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1. Paper 3F, *op.cit.*, p. 17.

deflators for consumption expenditure similar explanatory variables were used except that import prices were dropped and in the motor vehicles equation and the equation for other durables the relevant sales tax rates were added to the explanatory variables. The equations reported for motor vehicles and other durables had somewhat lower associated R^2's than the equation for GNE and the equations for motor vehicles showed significant serial correlation in the disturbances. ULCN did not prove to be much superior to ULC in the durables equations but it was superior in the non-durables equations. Average earnings were again significant in all cases reported and, as in the case of the GNE equations, did not prove to be inferior to ULCN. Sales tax rates were always highly significant. The demand pressure variables were not generally significant in the durables equations but both unemployment and vacancies (current and lagged) proved to be significant in the non-durables equations.

In the equations for (e), (f) and (g) ULC performed poorly and ULCN was significant for construction and investment in equipment. Average earnings were significant only in the construction equation. The demand pressure variables had significant coefficients in all equations reported for dwellings, in none of the equations reported for equipment and in only two out of eight for construction. The construction equations showed evidence of serially correlated disturbances.

Hence, on the whole, the sectoral equations reported in Paper 3F were quite successful in using aggregate explanatory variables. In most cases it can be said that both costs (in the form of ULC, ULCN or average earnings) and demand (represented by unemployment or vacancies) significantly influenced price levels and that using some combination of these variables as well as the lagged dependent variable (which was, of course, always significant) and dummy variables to account for seasonal influences in the data series, suitable equations explaining the implicit deflators were obtained. R^2's were generally very high and in only two of the equations did serial correlation of the disturbances prove to be a problem.

Turning now to the price equations of RBA1 (Occasional Paper 3G) we have separate equations for:

(a) the implicit deflator for personal consumption expenditure on non-durables,

(b) the implicit deflator for personal consumption expenditure on household durables,

(c) the implicit deflator for personal consumption expenditure on purchases of motor vehicles,

(d) the implicit deflator for gross fixed capital expenditure on dwellings,

(e) the implicit deflator for gross fixed capital expenditure on construction,

(f) the implicit deflator for gross fixed capital expenditure on equipment,

(g) the implicit deflator for government expenditure: current,

(h) the implicit deflator for government expenditure: capital, and

(i) the Consumer Price Index.

Comparing these equations with those in Occasional Paper 3F we find that three new equations have been added, viz., those for the implicit deflators for government expenditure and an equation explaining the CPI.

Consider, firstly, the equations explaining the implicit deflators (a)-(f) above. In all these equations the total vacancies variable experimented with in Paper 3F has been dropped and unemployment has been used to represent demand pressure. This is probably for two reason: firstly, in the equations reported in Occasional Paper 3F the vacancies variable was not consistently superior to unemployment and secondly, unemployment is explained by the RBA1 model whereas vacancies are not. The unemployment variable is used without a lag and only in equations for non-durables, investment in dwellings, investment in construction and investment in equipment. Its coefficient is significant in the first two of these equations. Another change in equations for (a)-(f) which is worth noting is that the average earnings variable is used exclusively to represent labour costs. The reasons for this are probably similar to those advanced above in the case of vacancies and unemployment. The average earnings variable is used in all the equations but its coefficient is insignificant in the two consumer durables equations. In contrast to the results in the previous paper, the sales tax rate variable in the motor vehicles equation is not significant in this case. In fact, in the equation for this sector only the lagged dependent variable has a significant coefficient. A new variable was introduced into the consumer goods and investment goods equations except the motor vehicles equation. The new variable is the expected change in the CPI and is defined by equation (27) of RBA1 as:

$$(3.7) \qquad PCPICE = 100.JW(J4P(PCPI)),$$

where PCPICE = the expected change in the CPI,

JW = a 12-period weighted moving-average operator,

J4P(PCPI) = a 4-quarter percentage change of the CPI.

This variable is significant in only two of the five equations in which it was introduced. The R^2's associated with the equations range from 0.860 to 0.998 and there is little evidence of serially correlated disturbances.

Turning now to the remaining price equations in the model we find that both government expenditure deflators are explained in terms of the implicit deflator of GNP, the equation for capital expenditure also including two seasonal dummy variables. The R^2's for these two equations show a good fit but the Durbib-Watson statistics indicate serially correlated disturbances. Finally, the CPI is explained by the CPI lagged one period and a complex variable involving current and lagged values of (a), (b), (c) and (d) above.[1] Thus while the price equations in RBA1 are obviously founded on the more detailed work of Occasional Paper 3F they have been changed in some cases to suit the purposes of the model and possibly also in the light of further experimentation.

Summing up briefly, the RBA equations present some support

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1. The estimated equation for the CPI is as follows:

$$PCPI = 0.008 + \underset{(77.37)}{0.991}\ PCPI_{-1} \sum_{j=1}^{4} \left[\sum_{i=1}^{4} w_{ji}\, P_i \Big/ \sum_{i=1}^{4} w_{ji}\, P_{i,-1} \right]$$

$$Se = 0.0039,\ R^2 = 0.996,\ DW = 2.11,\ CV = 0.004$$

where PCPI = the CPI

P_1, P_2, P_3, P_4 = (a), (b), (c), (d) above respectively, and

w_{ji} = exogenous weights.

for the arguments in favour of a sectoral approach to price determination. The estimated equations reported showed significant differences in the equations for different sectors. Thus, even though aggregate explanatory variables were used, both the size and the significance of the coefficients in different equations varied. Differences were also evident in both the average lengths of the distributed lags implicit in the estimated coefficient of the lagged dependent variable and in the lags of specific variables although most explanatory variables were used in current form. Somewhat surprising in relation to the arguments advanced in Chapter 1[1] was the apparent success of aggregate explanatory variables in the estimated sectoral equations especially as evidenced by the usually satisfactory R^2's. However, the favourable values for R^2 should be seen in the light of the fact that the equations were in the level form and the presence of the lagged dependent variable on the right-hand-side of the equations. Unfortunately, no estimated equations excluding the lagged dependent variable from the right-hand-side are reported in the studies (except the price equations for government expenditure). Further, some of the t-ratios for the estimated coefficients may be improved by the use of sectoral explanatory variables.

3.2.2 <u>The T-ABS Equations</u>[2]

The studies to be discussed here are in many ways similar to

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1. See pp. 2-6, *supra*.
2. C.I. Higgins, "Short-Run Wage-Price Dynamics, A Quantitative Analysis for Australia", Paper read at the Second Conference of Economists, Sydney, August 1961; C.I. Higgins, "A Wage-Price Sector for a Quarterly Australian Model", Paper read at the Australasian Conference of Econometricians, Monash, August 1971; C.I. Higgins and V.W. Fitzgerald, "An Econometric Model of the Australian Economy, *mimeo.*, March, 1973.

the Reserve Bank studies discussed above. Firstly, the equations form part of an econometric model of the Australian economy. Secondly, they also use a disaggregation of the Australian economy into final demand sectors and sectoral price levels are represented by implicit deflators of expenditure classes of GNP. Thirdly, the main theoretical background is developed in the two first-mentioned papers by Higgins and slightly more disaggregated equations are given in the full model contained in the Higgins-Fitzgerald report. So the procedure will be as above, i.e., to consider the Higgins papers first and then the price equations as incorporated into the March 1973 version of the model.

Initially, Higgins concentrates on one price variable, viz., the implicit deflator for home-produced GNE (denoted PHG) since it is felt to be the

> "... deflator of broadest scope which reflects domestic influences on domestic prices." [1]

Equations are also estimated for the consumption deflator, PC, since it is used as an explanatory variable in some wage equations. The

> "... preferred forms arising from the investigation of PHG are used to estimate equations for PC." [2]

In specifying the equations Higgins considers cost influences, demand influences and the influences of indirect taxes on prices.

Cost influences taken into account are restricted to unit labour costs partly for data reasons. Normal unit labour costs (ULCN) are used in preference to actual unit labour costs and are calculated

1. Higgins, (1971b), p. 21.
2. *Ibid.*

by a method based on the Canadian RDX2 model which uses a production function to estimate normal labour requirements which, in turn, are used to calculate ULCN. In relating ULCN to PHG Higgins prefers the distributed form:

$$(3.8) \qquad PHG = W(L)ULCN$$

to the simple mark-up form:

$$(3.9) \qquad PHG = (1+k)ULCN$$

since previous studies have found significant lags between labour costs changes and price changes to exist. As in the RBA equations, the variable (ULCN - ULC) was experimented with to

> "... allow for the possibility of a mixed system of pricing."

Secondly, consider the form of indirect tax rates as an explanatory variable. In the case where indirect tax increases are passed on completely the price equation takes the form:

$$(3.10) \qquad P = (1+ITR)W(L)ULCN$$

where ITR = the rate of indirect tax.

To fit the equation the price variable is expressed net of tax and equation (3.10) becomes:

$$(3.11) \qquad \frac{P}{(1+ITR)} = W(L)ULCN$$

Where indirect tax increases are partly absorbed, the equation takes the form:

$$(3.12) \qquad P = (1+B.ITR)W(L)ULCN$$

where B = the proportion of indirect tax passed on.

Since B would probably have a dynamic structure, difficulties of non-linear parameters would occur if (3.12) were written in the same form as (3.11). To overcome this problem two alternative forms are proposed:

$$(3.13) \qquad P = W_1(L)ULCN + W_2(L)ITR$$

or, following RDX2:

$$(3.14) \qquad \frac{P}{(1+ITR)} = W_1(L)ULCN + W_2(L)ITR$$

Finally, to include demand pressure in the pricing equations, the ratio of total vacancies to the number of unemployed was used as a proxy. The rate of change of this ratio was also experimented with in initial estimations but was found to be insignificant.

Now consider the estimation results. The equations originally estimated were of the form:

(3.15)

$$\left.\begin{matrix} P \\ \text{or} \\ \dfrac{P}{(1+ITR)} \end{matrix}\right\} = W_1(L)ULCN + W_2(L)ITR + W_3(L)\frac{V}{U} + a(\dot{\frac{V}{U}}) + b(ULC-ULCN) + C$$

Three estimated equations were reported with PHG as the dependent variable and two with PC as the dependent variable. As indicated in equation (3.15) distributed lags were used for ULCN, ITR and V/U in all equations. They were not successful for V/U but 7-period lags proved useful for the other two variables. Neither of $(\frac{V}{U})$ and (ULC − ULCN) proved useful. In the equation where PHG is the dependent variable the weights on both ULCN and ITR are positive and declining. The coefficient of the demand pressure variable, V/U, is not significant at the 10% level of significance. Serial correlation of the disturbances was found to be a problem in this equation as in all the other equations reported in the Higgins (1971b) paper. All equations reported in this paper have, however, been corrected for first order serial correlation. In the serially uncorrected equations for PHG, V/U was often significant. Despite V/U being insignificant in the serially corrected equations, it was retained in the preferred form because

> "... the sums of the weights on lagged indirect taxes, where V/U is included, are generally more realistic than when V/U is excluded."[1]

Thus when an equation of the form:

$$(3.16) \qquad PHG = a + b(V/U) + W_1(L)ULCN + W_2(L)ITR$$

is estimated the weights on ITR are positive and declining as expected *a priori*. But when V/U is dropped and the equation estimated is of the form:

$$(3.17) \qquad PHG = a + W_1(L)ULCN + W_2(L)ITR$$

the weights on ITR are V-shaped and all negative except the first which seems an unacceptable pattern. As expected, in the equation with PHG/(1+ITR) as dependent variable the weights on ITR are all negative and decline in absolute value. But

> "... in general the tax variable was insignificant at conventional levels."[2]

The weights on ULCN in all equations are positive and decline monotonically. The preferred PHG equation incorporated into the July 1971

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1. *Ibid.*, p.29.
2. *Ibid.*, p.29.

version of the T-ABS model was of the form of (3.16) above with the average lag on ULCN being 2.7 quarters and the average lag on ITR being 2.2 quarters.

Turning now to the estimated equations for the price of consumption, we find that again, in both the equations the demand pressure variable V/U is insignificant. In the equations with PC as the dependent variable the weights on ULCN are positive and declining and the weights on ITR are V-shaped with the first two weights being positive and the remainder being negative. In the equation with PC/(1+ITR) as the dependent variable the weights on both ULCN and ITR are positive and declining. The preferred form of this equation retains V/U and has PC as the dependent variable.

Now consider the price equations in the paper by Higgins and Fitzgerald.[1] This study contains the estimated price equations explaining the following variables:

(a) the implicit deflator for consumption less imports,

(b) the implicit deflator for non-consumption, non-inventory national expenditure less imports, and

(c) the implicit deflator for non-farm inventory investment.

Other price equations are included but these are identities and will not be considered here. Consider firstly, the consumption less imports equation. It is similar to the consumption equation discussed above - the dependent variable is the price level and the explanatory variables are the rate of sales tax, the ratio of vacancies to unemployment and normal unit labour costs. In this case the demand pressure variable, V/U, is significant and both the other explanatory variables are used with a distributed lag. The weights on the sales tax variable are all positive and declining and the weights on ULCN first increase and then decrease. The implicit deflator for non-consumption, non-inventory national expenditure less imports is explained solely by ULCN and a trend variable. The equation is of the form:

$$(3.18) \qquad PBLD = (a+bQTIM)W(L)ULCN$$

where QTIM = a dummy variable representing time

$$= \begin{cases} 100 \text{ in } 1958III \\ 101 \text{ in } 1958IV \\ 102 \text{ in } 1959I \\ \quad \ldots\ldots \end{cases}$$

The weights on ULCN are all positive and declining. The equation explaining non-farm inventory investment is estimated in the ratio form:

$$(3.19) \qquad \frac{PSNN}{PSNN_{-1}} = a + b\,\frac{PDHE}{PDHE_{-1}},$$

where PSNN = the price of non-farm inventory investment,

PDHE = the price of national expenditure on home-produced, non-inventory goods and services.

The estimated equation does not appear very satisfactory with an $\bar{R}^2$ of 0.224 and showing evidence of serially correlated disturbances at the 5% level. The coefficient of $PDHE/PDHE_{-1}$ is significant at 5%.

3.3 Conclusions

The two disaggregated models of price determination for Australia discussed in the previous section of the chapter have many similarities which appear to be the result of both being designed to form price "submodels" of larger econometric models of the Australian economy. Besides considerations of data availability, this purpose of the equations influenced to some extent the types of price variables used (implicit deflators) since these are in terms of final demand categories and can therefore be used in conjunction with constant dollar expenditures estimated elsewhere in the model. Another feature of the equations (probably also influenced by their purpose) is that the explanatory variables are, on the whole, aggregate ones. Thus aggregate unit labour costs and aggregate demand pressure variables are used. In the RBA equations, however, "sectoral" indirect sales tax variables are used in some equations.

Comparing the price equations of the two models, the Bank "submodel" shows more disaggregation. However, Higgins and Fitzgerald promise a

> "considerable disaggregation of prices and a more elaborate treatment of the effects thereon of import prices using input-output data for extraneous specification of some parameters."[1]

Both models appear to have much the same theoretical basis, i.e., prices are determined by unit costs (only labour costs being used), the pressure of demand in some cases and indirect taxes where applicable. In addition, the Bank also experimented with import prices (these being dropped in the model in Occasional Paper 3G) and the expected change in the CPI.

Comparing the lag structure of the two studies we find that in the Bank equations it is assumed that the coefficients of

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1. Higgins and Fitzgerald, *op.cit.*, Appendix A, p.xiv.

equation (3.3) above are generated by a general Pascal distribution (for the case $k = \infty$). Hence each of the explanatory variables are assumed to enter into the equations with coefficients generated by this distribution. A result by Jorgenson on rational distributed lags is then used to transform the equation into the form of (3.4) and this is truncated to give an equation with the dependent variable of the left-hand-side and the explanatory variables (not in the distributed lag form) plus the dependent variable lagged one period on the right-hand-side. This form is used in both papers 3F and 3G. In the estimated equations the lagged dependent variable is usually found to be highly significant (as expected). Estimation results showed significant differences between the estimated coefficients of the lagged dependent variable. If this variable is considered to be the result of a "Koyck transformation" applied to a geometrically declining distributed lag, the average lag implied in the estimated value of the lagged dependent variable varies from ½ quarter to 6 years.

In the T-ABS equations we find that the Almon method of estimating the coefficients of the distributed lag has been used. In the estimated equations presented in these studies we find that often the weights decline monotonically but that this is not always the case (especially in the case of the weights on the tax variable). Further the method employed in the T-CBCS model allows for the use of different lag structures for different explanatory variables. If some of the results are compared we find that the average lags are not as long in the Higgins-Fitzgerald equations. Thus in the equations for consumption less imports the average lag on the tax variable is 1.76 quarters and on unit labour costs it is 3.69 quarters. Similarly, in the "investment" equation the average lag on ULCN is 1.53 quarters.

Thus having surveyed the two important studies of price determination in Australia, we find that only one of the various methods of disaggregation used in overseas studies (see Chapter 2) has been used. We have seen that different types of disaggregation have been used in the overseas studies surveyed in the previous chapter and the next section of this chapter will contain proposals for using these types of disaggregation for Australia. It will also be proposed to carry out further work using the demand-type disaggregation since the overseas studies have used some explanatory variables which have not been used in the Australian studies.

3.4 Proposals for further testing

In this section we shall draw on the discussion of the preceding part of this chapter and of the previous chapter in order to prepare a programme for the econometric work to be carried out in the following chapters. This programme will be built up in stages. First, we will consider the type of disaggregation to be used. Secondly, we will consider the form and type of the dependent variable. Thirdly, the various explanatory variables to be tested will be discussed and finally the proposals for the testing of lag structures and any other features will be described.

3.4.1 Types of Disaggregation

In the sectoral studies discussed in Chapter 2 disaggregation by industry was commonly used. Two of the studies used this type of disaggregation in conjunction with the input-output model.[1] The two British studies by Neild and Phipps appear merely to have selected several industries for which data were available and used data for these industries for their analysis. In the U.S. study by Schultze and Tryon, on the other hand, there has been an attempt to disaggregate the entire economy or, at least, a large part of it. It is felt that, data permitting, the latter approach is preferable for the purposes of this thesis since the object is to analyse price determination in the Australian economy using a disaggregated approach rather than to study price determination in several Australian sectors. The possibility of using the input-output model will be discussed below when the explanatory variables are considered. Of the studies using the industrial disaggregation only Schultze and Tryon appeared to have discussed the reasons for their choice of type of disaggregation. They state that an industrial disaggregation was used (i) because the "decision-making framework" corresponds more closely to sectors defined by industry, and (ii) because most of the available data relate to this type of disaggregation. Since this type of disaggregation has been used with some success in overseas studies and has not been used in Australian studies it is felt to be worth experimenting with here.

The second type of disaggregation to be considered is

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1. See the studies by Eckstein and Fromm (1959) *op.cit.*, and Agarwala and Goodson, *op.cit.*

disaggregation by categories of consumer goods. It should be noted that this type of disaggregation is not a disaggregation of the entire economy but of that part of the economy producing consumer goods, the disaggregation being by consumer goods categories. The only study in which sectors defined in this way have been used is the one by Agarwala and Goodson for the U.K. Agarwala and Goodson used consumer goods sectors because their object was to examine the effects of certain economic policy actions on consumer goods prices and they expected these policy actions to have different effects on different sectors. An investigation of consumer prices in Australia would be of interest for two reason - firstly, because the CPI is most commonly used as a measure of the rate of inflation, and secondly, because the CPI often features in wage demands based (partly at least) on past and likely future increases in the CPI.

The third type of disaggregation to have been used in overseas studies is disaggregation according to the stage of production. In his discussion of inflation, Moulton suggests that this type of disaggregation may be useful to show the spread of price rises from demand sensitive basic raw materials through to final goods. Schultze also used this type of disaggregation by regrouping sectors as defined by the WPI and found that the further advanced the stage of production the more cost-determined is the price of the commodity. Evans' equations for the Wharton model also imply this type of hypothesis, i.e., that retail prices are largely determined by manufacturing prices (the prices of output of the previous stage of production). In fact, the study by Evans is the only one which contains estimated price equations based on this type of disaggregation. The form of

Evans' equations, however, appears to be based on *a priori* reasoning only (see above, p. 20., Ch. 3) with no testing of alternative forms reported. Therefore the question remains as to whether retail prices are largely determined by manufacturing prices or whether both are perhaps influenced by similar factors or by different factors moving in a similar way. However, the *a priori* reasoning by Evans and also by Schultze and Moulton, and the results obtained do give the ideas sufficient plausibility to warrant some attempt to test them.

The fourth type of disaggregation to be considered is disaggregation according to final demand categories. As noted previously, this type of disaggregation has been used in the two Australian studies discussed in the previous section of this chapter and in the study by Evans considered in Chapter 2. As indicated, further work will be carried out using this type of disaggregation.

Finally, the fifth type of disaggregation mentioned in Chapter 1 is disaggregation by geographical sectors. This type of disaggregation was not used by any of the Australian or overseas studies reviewed. The most obvious way of disaggregating the Australian economy by geographical sectors is to consider each State as a separate sector. This type of definition also appears the most promising as regards data availability.

Considering the type of sectors defined and discussed earlier in this thesis it appears feasible to combine a geographical disaggregation with one of the other types of disaggregation already discussed. Thus, we could first disaggregate the economy into sectors defined by States and then further disaggregate each State into, say, industrial or final demand sectors. Apart from considerations of data availability this type of "double disaggregation" will be considered to be outside the scope of this thesis. Hence, geographical disaggregation will be taken to mean that each Australian state is equivalent to a sector. From this definition the question arises as to what type of price to use to represent the price level of each sector. Theoretically, we could consider industrial prices, consumer prices or implicit deflators but it is anticipated that data availability will limit the choice so that this matter will be deferred till later.

When considering the estimation results it will be important to take into account whether the measure of the price level used for each State is a measure of the prices paid by residents of the State or a measure of the prices of the products produced within the State. If the former definition is used we would expect inter-sectoral dependence where some goods consumed within a State are produced within another State (or States), and hence the measure of the sectoral price level used will be important when we consider the questions which will be asked of the estimated sectoral price equations. We would not expect this type of interdependence if a measure of the price of the goods produced within a State is used.

3.4.2 The Dependent Variable

The studies reviewed in the previous chapters suggest that the type of dependent variable used is usually determined by the type of disaggregation used. Thus the two Australian studies discussed in this chapter used the final demand type of disaggregation and used implicit deflators to represent sectoral prices. Schultze also used implicit deflators to represent sectoral prices when considering sectors defined by final demand categories. When an industrial disaggregation was used an industrial price index (e.g., the WPI for the U.S.) was used to represent the sectoral price levels. The exception to this rule is the study by Schultze and Tryon in which three types of price variables are used within the framework of an industrial disaggregation, viz., WPI numbers, value-added prices and implicit deflators. In the present study we will follow the studies which allow the type of price variable to be determined by the type of disaggregation used.

The form of the dependent variable also varied between the studies. Three different forms are to be found in the studies reviewed, viz., the price level, the first difference in the price level and the percentage change in the price level. As noted, Eckstein and Fromm use all three forms of the dependent variable and note that there are (statistical) problems associated with the use of all three. They state these as follows:

> "Equations for price levels are vulnerable to multicollinearity introduced by common time trends, and are uncomfortably close to the identity of value, that is, price equals the sum of unit costs and unit profits. One-quarter differences show less of these difficulties, but given the small changes in the variables which occur from one period to the next, the errors of measurement are large compared to the actual price movements. Indeed, since the indexes are quoted to the nearest tenth of a point, rounding alone loses considerable quarterly variation. The four-quarter differences are a good compromise in these regards, but suffer from the autocorrelation induced by overlapping data." [1]

1. Eckstein and Fromm (1968), *op.cit.*, p. 1170.

Wilson, using first differences, considers possible errors of observation and taking the following example,

Index level	125.7 ± 0.1
Typical first difference	1.5 ± 0.2

notes that

> "... errors of observation account for 20 percent of the variance in first differences ..." [1]

Since the relative importance of these problems is not known in advance, the most desirable course would have been to experiment with all three forms and make a choice if necessary, after such experimentation had been carried out. Unfortunately, however, this course of action is impossible if only for reasons of time and it was decided to estimate only price level equations.

3.4.3 Explanatory Variables

We will now consider the explanatory variables which have been used in the studies reviewed in this and the previous chapter. The discussion will proceed variable-by-variable, reference being made to the different form the variable has taken in different studies and to the success with which it has been used. Variables which appear to have been successful in the studies reviewed will be used in several different ways. First the explanatory variables which have proved successful in the Australian studies will be tried in price equations based on types of disaggregation other than the final demand type. Secondly, the sectoral counterparts of successful Australian

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1. Wilson, *op.cit.*, p.65.

variables will be used with Australian data disaggregated by demand categories. Thirdly, variables which haveproved to be successful in any one of the overseas studies discussed in Chapter 2 will be tried in equations based on all types of disaggregation, not merely the type used in the study concerned.

Most, if not all, of the studies considered, both the Australian and overseas, have found labour costs the most important variable in the cost group and, in fact, the most important of all explanatory variables.[1] In most cases the emphasis has been on unit labour costs rather than, say, a wage rate or earnings variable. In the early work discussed in the first section of the previous chapter where, generally, no price equations were estimated, wage variables were often used although in most cases the effect of productivity was also mentioned. In the price equation studies the wage cost variable is usually adjusted for productivity and the method of adjustment used gave rise in many studies to a distinction between actual unit labour costs (ULC) and "normal" unit labour costs (ULCN). In these studies ULC was usually a wage or earnings variable adjusted for short-run changes in productivity and ULCN was obtained by adjusting the wage or earnings variable only for long-run productivity movements or standard or normal labour requirements. In the majority of cases ULCN was used in preferred equations. However, this was not always the case. Thus the studies by Schultze and Tryon and by Eckstein and Fromm found ULCN to be significant but Evans found a ULC variable to

1. A discussion of the problem of measuring the relative importance of explanatory variables in regression equations in this study will be found in the discussion of empirical results in Ch. 5.

be significant. Phipps, in his disaggregation study for the U.K., experimented with two types of labour costs and found both to be significant but for different sectors. If we look at the Australian studies we also find mixed results. In RBA paper 3F the authors reported that the substitution of ULCN for ULC in the regression equations generally led to an improvement in the fit of the equations and to an improvement of the t-ratio associated with the estimated coefficient. It should be noted, however, that this was not the case for all equations and that if equations using ULCN to represent labour cost are compared with the same equations using average earnings to represent labour cost the reported improvement in the estimated equations (in terms of R^2 and the t-ratio) is not generally apparent. In fact, in the RBA1 model reported in Paper 3G average earnings are used to represent labour cost in all the equations. The T-ABS studies used ULCN in the preferred equations since the

> "... use of normal unit labour costs, which abstracts from short-term productivity movements, generally provides a more accurate simulation result." [1]

Thus, on the whole, the empirical results seem to favour ULCN rather than ULC but they also indicate that average earnings and ULC ought not to be rejected in advance. Further in contrast with the Australian studies, it is proposed to use sectoral labour cost variables rather than aggregate ones.

Given that ULCN will be experimented with in the equations, it must be decided how to calculate ULCN. Again, various methods

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1. Higgins (1971b), *op.cit.*, p. 22.

have been used with no testing of alternative methods in the same study. The simplest method has been to divide a wage or earnings variable by a long-term moving average of productivity or by an externally estimated constant rate of increase in productivity.[1] More complicated methods were used by Eckstein and Fromm, by the RBA who used Eckstein and Fromm's method, and by Higgins. With respect to the first two methods, it is felt that long-run changes in productivity should be taken into account and that, therefore, ULCN should be computed using a long-term average of productivity. Further, it is felt that the simplest method ought to be experimented with first. If this is unsuccessful other methods could then be tried if data permit.

In the equations where ULCN was used, a variable ULC - ULCN was also often used to test for the presence of both oligopolistic and competitive pricing. The results obtained using this variable were mixed. Eckstein and Fromm generally found it significant while in the study by Schultze and Tryon it was found to be significant in some cases only. In both Australian studies it was not significant.

Thus concerning the labour cost variable, many different variables have been used and there appear to be few general conclusions to be drawn with respect to their success. However, it appears that ULCN is likely to be more successful (in terms of R^2 and the significance of the estimated coefficient) than ULC or a wage or earnings variable and that ULC - ULCN could enter the equations with a significant but small coefficient. The Australian studies (see also

1. See the studies by Neild, *op.cit.*, and Phipps, *op.cit.*

Pitchford and Nieuwenhuysen and Norman[1]) indicate that wage or earnings variables ought to be tested, especially in a disaggregated study where it might be expected that different variables are important for different sectors. Since labour costs enter into the costs of production for each sector irrespective of the way in which the sector is defined, it appears that these comments are applicable to all types of disaggregation to be used, the definition of the sectoral wage and productivity variables depending on the type of disaggregation.

The second variable to be considered in the cost group is materials costs. As has been noted earlier, it appears from empirical research overseas that materials costs tend to become more important in pricing equations when they are estimated at a disaggregated level. Almost invariably, the materials cost variables have been found to be less important than labour costs variables in price determination equations and, perhaps as a result of this, less experimentation with the form of this variable has been carried out. Materials cost variables are not used at all in the two Australian studies reviewed in this chapter but have been found to be important in overseas studies and hence will be tested in this study. Several points emerge from overseas studies. Firstly, the materials price variable has usually taken the form of a quarterly index, though the Schultze-Tryon study has used both this form and a 4-quarter moving average of materials prices. The latter was found to be significant in some

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1. J.D. Pitchford, "An Analysis of Price Movements in Australia, 1947-1968", *Australian Economic Papers*, 7, December, 1968, pp. 111-135; J.P. Nieuwenhuysen and N.R. Norman, "Wages Policy in Australia: Issues and Tests", *British Journal of Industrial Relations*, 9, November, 1971, pp. 353-370.

cases and the former in others. Secondly, from Evans' study it appears that farm prices may be important in a price equation for non-durables. Thirdly, if a stage-of-production disaggregation is used we would expect materials prices to be important. Finally, the results obtained by Agarwala and Goodson using materials (and labour) costs within an input-output framework indicate that this hypothesis ought to be tested.

The only study so far reviewed which has stressed the importance of overhead costs is the 1959 study by Schultze. He split overhead costs up into overhead employment costs and the costs of capital consumption, and he argued that overhead costs were particularly important causal factors in the 1955-57 inflation in the U.S. He also argues that the increasing proportion of total costs accounted for by overhead costs accentuated the downward rigidity of prices since most overhead costs are relatively fixed and are, therefore, difficult to reduce if output falls short of the projected output on the basis of which overhead costs were incurred. However, none of the other studies so far discussed have attached importance to the independent effect of overhead costs on prices and an overhead costs variable has therefore not been tested in any price determination equations. Nevertheless, when considering labour cost variables in the regressions in this thesis it may be interesting to test whether the effects of overhead labour costs on prices is the same as that of non-overhead labour cost.

Another variable which has been used only rarely is profits. Eckstein and Fromm in their 1959 study of the U.S. steel sector found some evidence of the importance of profits. In their 1968 study they also included a profits variable, viz., the after-tax rate of return on real capital corrected by the operating rate to test whether changes in the target rate of return have any influence on prices. Since this variable was not included in any of the estimated equations reported in their study it may be assumed to have been unsuccessful. It is, therefore, not proposed to test this variable especially in the light of Wilson's comments that increases in profit margins are probably the result of strong demand.

The only remaining cost variable which appears to have been important in several studies is the rate of sales tax. This is especially true for the Australian studies and it is, therefore, proposed to test this variable in sectoral price determination equations to be presented later in this thesis.

We will now consider the second group of explanatory variables, viz., the demand variables of which two types will be distinguished: (i) variables measuring the pressure of demand or excess demand in the product market, and (ii) proxy variables measuring the pressure of demand or excess demand in the labour market. In general we find that, with the exception of the study by Neild, all the overseas studies discussed in Chapter 2 have used variables of type (i) and both the Australian studies have used labour market proxies which fact is due mainly to the unavailability of suitable product market demand variables in Australia. Considering the type (i) variables first, we find that several different variables have been used. The most important of these are capacity utilization, orders data, and the inventory/sales ratio. A capacity index has been the most favoured and would appear to give the best indication of demand relative to supply though it has been unsuccessful in some cases possibly because of poor data.[1] Hence we would expect this variable to be important if suitable data could be found. Cruder measures of capacity utilization have been used by Phipps (Kuh's demand ratchet) and Wilson (output relative to previous peak output) and these could be used if satisfactory capacity utilization series are unavailable. One other measure used by several studies is the change in output or expenditure (used by Schultze, Eckstein and Fromm (1959), Wilson, Agarwala and Goodson).

Let us now turn to the labour market variables which have been used as proxies for demand pressure in the product market. As mentioned earlier, the study by Neild is the only overseas study in which this type of measure (in this case the Dow-Dicks-Mireaux index of excess demand in the labour market) has been used. Neild found the variable highly insignificant and concluded that

> "... this rejection of demand influence seems fairly decisive, but it remains possible that a more complex formulation or a different indicator might lead to a different conclusion." [2]

The measure was not tested in the disaggregated equations. Rushdy and Lund,[3] in a re-examination of Neild's conclusions found some support for the includion of the Dow-Dicks-Mireaux index in the aggregate pricing equation. The conclusion is not very strong and

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1. See Schultze and Tryon, *op.cit.*
2. Neild, *op.cit.*, p. 20.
3. F. Rushdy and P.J. Lund, "The Effect of Demand on Prices in British Manufacturing Industry", *Rev. Ec. Studies*, 34, October, 1967, pp. 361-373.

they state that

> "... the level of demand cannot be dismissed as being an insignificant factor in the explanation of the price changes of manufactured goods, even after its effects on costs (wages and materials) have been accounted for." [1]

Both the Australian studies used labour market proxies to represent demand pressure in the product market. The RBA studies used both the number of unemployed and the number of vacancies (both for the whole economy) separately and found that both variables performed satisfactorily. Only the level of unemployment was used in the RBA1 model. It was found to be significant in only two equations suggesting either that the pressure of demand is important in some sectors only or that the proxy is not a very satisfactory measure of demand pressure, or both. Thus, it appears that further experimentation is necessary with (i) sectoral rates or levels of unemployment and/or vacancies, and (ii) other demand variables. The studies by Higgins and Higgins and Fitzgerald for the T-ABS model also used labour market variables. It will be recalled that in the paper by Higgins the ratio of vacancies to unemployment was used in both the PC and PHG equations but that in all equations reported it was insignificant. This variable is also used in the consumption less imports equation in the paper by Higgins and Fitzgerald. Another formulation of this variable used by Pitchford in aggregate equations is the ratio of vacancies less unemployment to the sum of employment and unemployment which he uses as a measure of percentage excess demand in the labour market. This form appears consistently significant in his equations and, intuitively, appears to be the most suitable form. Another measure of

1. *Ibid.*, p. 371.

demand pressure in the labour market is overtime hours worked used by Wilson and this will be tested in this thesis.

A final variable which does not fall into either the cost or demand categories is price expectations. Only one of the studies reviewed in the previous two chapters has used a variable representing expected prices (or price changes), viz., the RBA paper 3G. The neglect of price expectations in price determination equations is probably due to two main factors: (i) price expectations are not likely to be very important in the process of price determination if the rate of price increase fluctuates irregularly between zero and, say, 3 or 4% p.a. as it has done in Australia for much of the post-war period, and (ii) expected price is very difficult to quantify and hence there are significant problems in testing the importance of price expectations. If price expectations do, in fact, have a significant effect on price changes, it would appear that a large part of this effect would occur indirectly by way of the effect of expectations on wages and demand, both of which already enter as explanatory variables.

Apart from the question of whether price expectations are likely to have an effect on price independent of their effect on wages and demand, there is the question of the measurement of expectations. In the absence of a directly observable price expectations variable, expectations have almost always been measured by a combination of past prices[1] and if this type of variable has a significant coefficient in a price equation one cannot be sure whether this means that

1. See e.g., Norton and Henderson, *op.cit.*, and R.M. Solow, *Price Expectations and the Behaviour of the Price Level*, (Manchester: Manchester University Press, 1969).

the cost and demand variables should enter into the equation with an infinite distributed lag. In view of these uncertainties, it has been decided not to experiment with an expectations variable in this study.

3.4.4 Lag structures and other features

In general, the studies reviewed in Chapter 2 have shown that the greater part of the adjustment of prices to the explanatory variables used is accomplished within two quarters. Several of the studies have used a distributed lag resulting in the inclusion of the lagged dependent variable on the right-hand-side of the equation. Neild estimates equations of this type which result from the imposition of a geometrically declining lag on both materials and wage costs and finds the coefficient of the lagged dependent variable to be always highly significant in his aggregate equations. He also performs tests on alternative lag specifications for both wage and materials costs the results of which tend to confirm that geometrically declining lags were, in fact, appropriate. As mentioned above, Phipps is rather sceptical of the validity of the results obtained by Neild using this type of lag structure. Further, experimentation was carried out only with aggregate equations and no separate experimentation is reported for the sectoral equations which all have the lagged dependent variable on the right-hand-side. The other studies to use the lagged dependent variable on the right-hand-side were the ones by Evans and Eckstein and Fromm, both of which expressed doubt as to the conclusions which could be drawn from the estimated coefficients of that variable especially in price level equations and both of which stated that adjustment of prices to cost changes is likely to be rather quick.

When we consider the two Australian studies reviewed in this chapter, we find that more sophisticated lags were used. The RBA studies assumed that actual prices were related to equilibrium prices (and hence the explanatory variables) by a distributed lag, the weights of which are generated by a general Pascal probability distribution. Under various simplifying assumptions equations are obtained and estimated which have the current values of the explanatory variables (in some cases also with a one period lag) plus the lagged dependent variable on the right-hand-side of the equation and those are to be viewed with the same caution as the Koyck-type equation. As has been the case in previous studies, the coefficient of the lagged dependent variable is almost always highly significant and often large. The T-ABS equations, on the other hand, use Almon distributed lags on ULCN and indirect taxes. In all equations reported the weights on ULCN are positive and declining. On the tax variable (which is usually insignificant) there is no consistent trend. Commenting on the preferred equations for PC and PHG Higgins says

> "Although some of the preferred equations seem reasonable no emphasis is placed on the implied estimates of the extent to which indirect tax changes are reflected in prices."[1]

Thus, in conclusion, it appears that short one or two period lags will be the most useful (and also the easiest to experiment with) but that longer lags ought to be experimented with (especially Almon-type lags) in the light of the results of the T-ABS equations.

1. Higgins, *op.cit.*, p.32.

The only remaining aspect of the studies discussed to be considered for testing with Australian data are the various tests carried out to ascertain whether the response of prices to demand and cost changes is asymmetrical.

The asymmetry hypothesis appears to have been first suggested by Schultze in his 1959 JEC study and, in fact, much of his explanation of the 1955-57 U.S. inflation was based on the hypothesis that firms increased prices more readily (and by a greater amount) in the face of excess demand than they reduced prices in the face of deficient demand. Schultze finds some evidence for this for the 1955-57 period.

A more thorough test of this hypothesis was carried out by Schultze and Tryon. It will be recalled that to represent the pressure of demand on prices, they used, *inter alia*, the deviation of capacity utilization from normal. To test the asymmetry hypothesis they split this variable up into positive and negative deviations and enter these as two separate variables in the price equation. If the hypothesis is correct we would expect the coefficient of the positive deviations to be greater than the estimated coefficient of the negative deviations. The hypothesis was tested using both the six broad industry groups and the 2-digit industries and was found to be supported in many industries.

As mentioned previously, Eckstein and Fromm used two different methods to test for the asymmetry of price change to cost change. In the first the variable ULC - ULCN was split into two variables, viz., one for positive deviations and one for negative deviations. If the asymmetry hypothesis is correct we would expect the estimated coefficient of the positive deviations to exceed the estimated coefficient of the negative deviations. In the second, quarters during which prices should have risen according to the estimated equation were indentified, the equation was re-estimated for these quarters and we would expect the coefficient of the cost variables in the re-estimated equation to be greater than the corresponding coefficients in the original equation. The results of both these tests provide only weak evidence of asymmetry. But Eckstein and Fromm note that part of any downward price rigidity is already accounted for by the use of "normal" unit labour costs which are not affected by short-run productivity changes.

Thus, overall, it appears that overseas studies provide some evidence (although weak) of asymmetrical response of prices to cost and demand changes. Furthermore, Schultze and Tryon's more disaggregated study found this factor to be important for certain sectors and since this thesis is to be concerned, *inter alia,* with investigating sectoral differences in price determination, it is felt that the hypothesis should be entertained.

CHAPTER 4

D A T A

4.1 Introduction

Having outlined the proposed programme of work for this thesis in the final section of the previous chapter, it is now necessary to consider the data which are required to carry out this programme. This will be the first task to be undertaken in this chapter; it will be contained in section 4.2. Section 4.3 will deal with the question of the availability of the data shown to be required in section 4.2. It will transpire from the discussion of this section that some of the required data which are not available in the proper form can be constructed from available data. In section 4.4 we will discuss this data in some detail together with the methods used to construct it. All constructed series will be reproduced in Appendix 4.2. The final section of this chapter (section 4.5) will contain an evaluation of the data to be used.

4.2 Data Required

This section will contain a discussion of the data required to represent the following six types of variables: prices (dependent variable), labour costs, materials costs, sales tax, product market demand variables and labour market demand variables (explanatory variables).

4.2.1 Prices

Data are required to represent price levels for sectors defined according to the following types of disaggregation:

(1) Industrial disaggregation,

(2) Disaggregation by expenditure categories,

(3) Disaggregation by stage of production,

(4) Disaggregation by consumer categories, and

(5) Geographical disaggregation.

In the case of sectors defined by disaggregation of types (1), (3) and (5) above we require for each sector a price index measuring the price levels of the goods produced in that sector and in the case of sectors defined by disaggregation of types (2) and (4) we require for each sector a price index measuring the price level of the particular class of goods covered by the sector.

4.2.2 Labour Costs

It will be recalled that in the previous two chapters a distinction was made between actual and normal unit labour cost. To compute *actual* unit labour cost (ULC) for a particular sector we require both wage-rate (or earnings) data and short-run productivity data for that sector. ULC ought to be based on the wage-rate if it is expected that a firm adjusts its prices only for changes in the wage-rate it pays its employees (after taking productivity into account) and on earnings if it is thought that prices are also adjusted to, e.g., changes in overtime earnings. To compute *normal* unit labour cost (ULCN) for each sector we require data representing long-run productivity for each sector in addition to wage-rate or earnings data. It will be recalled that long-run productivity will be calculated as a moving average of short-run productivity. Hence to calculate both ULC and ULCN, data for wage-rates, earnings and short-run productivity will be required for each sector. In the case of disaggregation of types (1), (3) and (5) the wage data for a particular sector should relate to those employed in the sector whereas in the case of disaggregations of types (2) and (4) it should relate to those employed in making the goods covered by that sector.

Besides ULC and ULCN, it was stated in the previous chapter that it would be worthwhile experimenting with an earnings variable on its own, unadjusted for productivity or with productivity as a separate variable. This will obviously not require extra data. Similarly, if we wish to experiment with a wage rate variable on its own with productivity as a separate variable no extra data will be required.

In addition it was suggested in the last section of the previous chapter that the effects of overhead and non-overhead labour costs should be tested for separately. For this we would require that the three types of series mentioned above be available for both overhead and non-overhead labour for each sector.

4.2.3 Materials Costs

In the case of materials cost the materials cost variable for an industrial, stage-of-production or geographical sector would be required to measure the cost of materials used by that sector. For an expenditure or consumer sector the materials cost data would be required to represent the cost of materials used in the manufacture of the goods covered by the sector.

It was further suggested in the previous chapter that materials costs and labour costs could alternatively be calculated for each sector by the input-output method used by Agarwala and Goodson. To ascertain the data requirements for the use of this method of computing unit prime costs it is necessary to examine the method in more detail than was done in Chapter 2 and for this reason the task has been deferred to subsection 4.2.7.

4.2.4 Sales Tax

The final cost variable to be discussed is the sales tax rate. For sectors defined by expenditure and consumer goods classes this variable will be taken to be the weighted average of the rates applying to the goods in the class since sales tax is generally levied on classes of goods rather than on, say, specific firms or industries. In the case of sectors defined by industry, stage-of-production or geographical area, the rate-of-sales-tax variable for a particular sector will be the weighted average of the rates applicable to the principal goods produced by the sector. Thus, to test the importance of the sales tax variable we require an index of the rate of sales tax for each sector (as described above) for which sales tax is likely to be important.

4.2.5 Product Market Demand Variables

Several variables representing the pressure of demand in the product market were suggested in the previous chapter. If all these are to be experimented with we require data for each sector for each of the following variables.

(1) Capacity utilization;

(2) Orders data;

(3) Inventory levels;

(4) Sales;

(5) Output;

(6) Expenditure.

In connection with item (1), it should be noted that "capacity utilization" is usually associated with a particular industry. It may, therefore, be difficult to define for a sector defined by disaggregations of types (2) and (4) and also for a stage-of-production sector where the same firm may be involved in the production covered by two different sectors. For these sectors capacity utilization will be thought of as the level of capacity utilization of those firms or industries principally engaged in the production of the goods which they cover. In the case of item (6) we face the difficulty of defining "expenditure" for an industrial sector since expenditure is usually disaggregated by type of purchaser (e.g., private, government) and by type of good (e.g., capital goods, consumer goods). Expenditure corresponding to an industrial sector will be taken to be the expenditure on the principal output of the sector by all types of purchasers. A similar difficulty arises in the case of the disaggregation of types (3) and (5) and it will be dealt with in the corresponding way.

4.2.6 Labour market Demand Variables

To implement the proposals outlined in the previous chapter regarding the importance of labour market demand variables in price equations, data for each sector for each of the following variables are required.

(1) Unemployment;

(2) Vacancies;

(3) The Dow-Dicks-Mireaux index of excess demand in the labour market;

(4) Overtime hours.

It is likely that difficulties will be faced in defining unemployment for sectors since it is unlikely that each sector will have its own isolated labour market where unemployment may be measured except, perhaps, in the case of geographical sectors. Hence an aggregate unemployment variable will be used in equations for expenditure, consumer, stage-of-production and industrial sectors and sectoral unemployment variables will be used in equations for geographical sectors. The same difficulties are not likely to be faced in the definition of vacancies and hence sectoral variables will be required for all sectors, vacancies for expenditure and consumer sectors being defined as vacancies in the principal forms or industries producing the goods covered by each sector. What was said in relation to unemployment applies also to the DDM index of excess demand in the labour market since this index is based, *inter alia,* on the rate of unemployment. Finally what was said in relation to vacancies applies also to the overtime hour variable.

4.2.7 Unit Prime Cost

Finally in this section we consider the data requirements for the calculation of unit prime cost using the input-output-based method proposed by Agarwala and Goodson in their study for the U.K.

It will be recalled that Agarwala and Goodson's initial equation was of the form:

$$(4.1) \qquad C = A.C + D.W. + E.M$$

where C = a vector of unit prime cost for industrial sectors,

A = the input-output matrix (transposed),

D = a diagonal matrix showing the proportion of unit cost formed by wage cost,

W = a vector of unit labour cost,

E = a diagonal matrix showing the proportion of unit cost formed by import cost, and

M = a vector of unit import cost.

It will also be recalled that in the actual calculation of unit prime cost the three vectors C, W and M on the right-hand-side of equation (4.1) were lagged one period. This will not be done in this section since the data requirements are not effectively different in the case where the unlagged version is used.

Equation (4.1) implies a prime cost equation for the i^{th} sector of the following form:

$$(4.2) \qquad C_i = a_{1i}C_1 + a_{2i}C_2 + \ldots + a_{mi}C_m + d_{ii}W_i + e_{ii}M_i$$

It should be noted that Agarwala and Goodson are primarily interested in the policy question of the effect of changes in import prices and wages on final goods prices via changes in prime cost. For the purposes of this thesis, where the primary object is to explain final goods prices, it appears to be preferable to change equation (4.2) (and hence equation (4.1)) to

$$(4.3) \quad C_i = a_{1i}P_1 + a_{2i}P_2 + \ldots + a_{mi}P_m + d_{ii}W_i + e_{ii}M_i$$

where P_j is the price of the output of sector j. This implies that unit prime cost for industry i is a weighted average of material input prices and wage rates. The use of equations of this type rather than equations similar to equation (4.2) to generate the successive C vectors will, of course, necessitate extra data, viz., time series data for $P_1, \ldots, P_m$ but this matter will be further discussed in the following section of this chapter.

If equations of the form (4.3) are used to derive unit prime cost series for each sector for the sample period the following data would be required:

(a) An input-output matrix.

(b) A vector of prices of the outputs of the sectors defined in the input-output matrix for each quarter of the sample period.

(c) A diagonal matrix whose diagonal elements are the proportions of unit cost formed by wage cost for each sector defined by the input-output matrix. This matrix would be fixed for the sample period, as would the input-output matrix.

(d) A diagonal matrix whose diagonal elements are the proportions of unit cost formed by import prices for each sector defined by the input-output matrix. This matrix would also be fixed for the sample period.

(e) A vector of unit labour cost corresponding to each sector defined by the input-output matrix for each quarter of the sample period.

(f) A vector of unit import prices for each sector defined by the input-output matrix for each quarter of the sample period. In their empirical application of this model Agarwala and Goodson took the i^{th} element of this vector for period t to be the price index of imports in period t used by the i^{th} sector. In fact, they used a 14-sector input-output matrix and found that import prices were available for only four different categories of imports so that they had to

> "... allocate these four import price categories to our input-output industrial categories on the basis of subjective judgement." [1]

Having now considered the data requirements for the computation of unit prime cost for the industrial sectors defined by the input-output matrix, let us consider the data required to permit conversion of the unit prime cost for industrial sectors into unit prime cost for other types of sectors. We will specifically consider only the conversion to consumer sectors. The conversion to other types of sectors (except geographical sectors) is achieved in an identical manner. Again, Agarwala and Goodson's description of the matrices used for conversion is very brief so that their method will have to be examined in more detail before we can decide what data are necessary.

It will be recalled that the equation used for conversion is:

1. Agarwala and Goodson, *op.cit.*, p. 61.

$$(4.4) \qquad C_c = R.C + B.M$$

where C_c = a vector of unit prime cost for consumer sectors,

R = a conversion matrix, and

B = a matrix showing the direct import content by industries of final consumption goods expenditure.

Previously it was assumed that there are m industrial sectors (i.e., the input-output matrix is m x m); further assume that there are n consumer sectors. Then the equation derived from (4.4) for the j^{th} consumer sector is as follows:

$$(4.5) \quad C_{cj} = r_{j1}C_1 + \ldots + r_{jk}C_k + \ldots + r_{jm}C_m + b_{j1}M_1 + \ldots + b_{jk}M_k + \ldots + b_{jm}M_m$$

Although the elements of the R and B matrices are only loosely defined by Agarwala and Goodson, it would appear that the typical element r_{jk} is the proportion of consumer expenditure on commodity class j which is devoted to the output of industrial sector k. Similarly, b_{jk} would appear to be the proportion of consumer expenditure on commodity class j which is met out of imports of goods similar to the ouput of industrial sector k. If this is the case then:

$$(4.6) \qquad \sum_{k=1}^{m} (r_{jk} + b_{jk}) = 1 \quad , \qquad \forall j = 1, \ldots, n$$

Then, to obtain the data necessary to carry out the conversion of the C vector into the C_c vector we would need estimates of all the r_{jk} and b_{jk} in addition to the C vector (for each period) which will be generated by equation (4.3) and the M vector for each period which will have been needed for the generation of the C vectors.

Two aspects of equation (4.5) will be remarked upon. Firstly, consider the definition of the b_{jk} elements. The definition of these elements given above is not given by Agarwala and Goodson but inferred from their definition of the B matrix which is as follows:

> "... matrix showing the direct import content *by industries* of final consumer goods expenditure." [1]

It is difficult to understand, however, why Agarwala and Goodson first allocate direct import prices to the industries defined by the input-output matrix and then proceed by means of matrix B to convert these categories to consumer expenditure categories. It would appear far simpler to make B a diagonal (nxn) matrix $\{b_{ij}\}$ $(b_{ij} = 0 \text{ if } i \neq j)$ and define a new n-component vector, M^*, whose elements, M^*_i, are import prices corresponding to consumer goods categories.

The second aspect of the conversion equation to be mentioned concerns the purpose of the second term in equation (4.4). Agarwala and Goodson make no mention of its purpose but point to the studies by Brown[2] and Fisher, Klein and Shinkai.[3] The study by Brown suggests that the second term is designed to take account of consumer goods expenditure on goods which are directly imported. While this seems reasonable for Brown's study which is concerned with expenditure, it appears unsuitable for inclusion in a prime cost equation of the type envisaged in this thesis since direct imports, by definition, do not

1. *Ibid.*, p.58, my emphasis.
2. Brown, *op.cit.*
3. Fisher, Klein and Shinkai, *op.cit.*

undergo further production before being sold to consumers and therefore do not form part of the prime cost of Australian producers. This is not to deny that the prices of direct imports do not affect prices for consumer goods but it seems preferable to test for this effect separately.

Finally, we must return to a brief discussion of equations (4.2) and (4.3) and their relation to data requirements. As mentioned above, use of equations of type (4.2) rather than (4.3) make the data requirements for the calculation of the C vectors for each period less rigorous. However, the use of (4.2) instead of (4.3) does not affect the data required to convert the C vector to the C_c vector.

Thus, in conclusion, there are several ways in which the data requirements may be simplified should certain data be unavailable. Firstly, if data for the P_j in equation (4.3) should be unavailable, equation (4.2) could be used instead of (4.3). Secondly, if data for the matrix B is unavailable B could be changed to a diagonal matrix (provided M also can be changed) as described above, or, alternatively, equation (4.4) could be simplified to:

(4.7) $$C_c = R.C$$

4.3 Data Availability

This section will discuss the availability of the data shown to be necessary in the previous section. Where the data are available in the form required the data actually to be used will be described. In cases where the data are unavailable in the required form but can be constructed from available data this is pointed out but a description of the method which is to be used is deferred to section 4.4. Where the required data are not available and cannot be constructed this will also be stated.

Unless stated otherwise all data to be used is quarterly and has been collected for the period 1959-60 to 1972-73. The regressions will be run using quarterly observations for the 13-year period 1960-61 to 1972-73. Since quarterly data are to be used, seasonal influences on prices must be considered. If prices vary seasonally, there are two methods of taking this into account. The first method is to seasonally adjust all price data and the second to introduce seasonal dummy variables into the regression equations. Neither of these methods have been used in this study for two reasons. Firstly, seasonal influences on prices are not likely to be marked and they have seldom been taken into account in price equation studies presumably for this reason. Secondly, the only price study mentioned in this thesis which has used seasonal dummy variables and hence made some attempt to measure seasonal effects on prices is the one by Pitchford[1] and in the equations reported in his study the estimated coefficients of the seasonal dummy variables are insignificant in all but one case.

The discussion in this section will proceed in the same order as that in the previous section so that a comparison of the data available with the data required will be facilitated.

4.3.1 Prices

Price data are unavailable for two of the five types of

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1. See Pitchford, *op.cit.*

disaggregation listed above in 4.2.1, namely, industrial sectors and stage-of-production sectors. No price index is currently published for Australia for industrial sectors. Furthermore, it appears impossible to find data from any source for even the majority of the broadest categories of the Australian Standard Industrial Classification.[1] Consequently in the remainder of this chapter we will be concerned only with the three remaining types of disaggregation - by expenditure (disaggregation type A), by consumer categories (disaggregation type B), and by geographical categories (disaggregation type C).

To obtain implicit deflators to represent prices for expenditure sectors the current price estimates of the various classes of expenditure were divided by the corresponding constant price estimates.[2] The availability of published quarterly constant price estimates limit the expenditure categories for which implicit deflators could be obtained to the following:

(a) Final private consumption expenditure (sector A1),

(b) Final government consumption expenditure (sector A2),

(c) Private gross fixed capital expenditure: dwellings (sector A3),

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1. See Australian Bureau of Statistics (A.B.S.), *Australian Standard Industrial Classification (draft)*, (Canberra, September 1968), Volume 1.

2. The source of statistics is : A.B.S. *Quarterly Estimates of National Income and Expenditure*, (Canberra), various issues. Note that while this discussion of the construction of the implicit deflators ought to be contained in the next section, it is, in fact, contained in this section so that the sectors to be used in this study may be defined before proceeding with the discussion of the data for the explanatory variables.

(d) Private gross fixed capital expenditure: other buildings and construction (sector A4),

(e) Private gross fixed capital expenditure: all other (section A5),

(f) Public gross fixed capital expenditure (sector A6), and

(g) Gross National Expenditure[1] (sector A7).

Sectoral prices for consumer categories are provided by the indexes for the following five groups of the Consumer Price Index:[2]

(a) Food (sector B1),

(b) Clothing and drapery (sector B2),

(c) Housing (sector B3),

(d) Household supplies and equipment (sector B4),

(e) Miscellaneous (sector B5), and

(f) The CPI for the aggregate case (sector B6).

Thus, using this type of disaggregation five sectors are distinguished. As in the previous case, aggregate equations explaining the CPI will also be experimented with.

The final disaggregation to be considered is the geographical disaggregation. Since constant price estimates of GNE are not available separately for the States, the CPI for each capital city had to be used to represent the price level in each geographical sector. Thus, the following sectors are distinguished:

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1. For all three types of disaggregation to be used in this study an "aggregate" equation (in this case one explaining the implicit deflator of GNE) will be estimated for the purpose of comparing the performance of the aggregate equation with the performance of the sectoral equations.

2. The source of statistics is: A.B.S., *Labour Report*, (Canberra), various issues.

(a) New South Wales (sector C1),

(b) Victoria (sector C2),

(c) Queensland (sector C3),

(d) South Australia (sector C4),

(e) Western Australia (sector C5), and

(f) Tasmania (sector C6).

As the aggregate price variable in this case would be the same as in the previous case (since both use CPI figures), no separate aggregate equations will be estimated for the geographical disaggregation.

4.3.2 Labour Costs

As mentioned in the previous section, both wage-rates and earnings variables are to be used to test the importance of labour costs in the price equation. They will be used separately, with productivity as a separate variable, in the form of ULC and in the form of ULCN. However, following discussion in the previous section we need only consider the availability of sectoral wage-rate data, sectoral earnings data and sectoral short-run productivity data. Let us consider firstly, the availability of sectoral earnings and wage-rate data. Both minimum hourly wage-rates (actual wage-rates and indexes) and minimum weekly wage-rates are available in A.B.S. publications. Minimum hourly wage-rates were discarded because they are available only from 1962 onwards whereas data for the period 1959-60 to 1972-73 are required as pointed out above. Minimum weekly wage-rate data are available for the whole of the 1959-60 to 1972-73 period, but only for industrial and geographical sectors. Thus, the required wage-rate data for type A and type B disaggregations are unavailable.

However it was constructed by taking weighted averages of the indexes for industrial sectors and a discussion of the procedure used is contained in section 4.4. Although minimum wage-rate indexes are available on a State basis, the indexes used for type C sectors were constructed from the State data so as to correspond as closely as possible with the dependent variable and a description of the method used is also contained in the following section.

Consider, now, earnings data. Data for average weekly earnings are published only for Australia as a whole and for the States separately and hence sectoral data for sectors defined by disaggregations of type A and type B could not be obtained or constructed. Hence it was decided to use the same series, viz., the series for Australia as a whole in the equations for each of the sectors A1, ..., A7 and B1, ..., B6 and to use the series for the States in the equations for sectors C1, ..., C6. A seasonally adjusted average weekly earnings series is also published by the A.B.S. and will be experimented with. It is, however, available only for Australia as a whole and will, therefore, only be experimented with as an alternative to the original series for Australia as a whole.[1]

Finally in this section on labour costs we will consider the availability of data to be used to represent productivity movements. Since there is no published information on productivity for the sectors defined in sub-section 4.3.1, data on productivity, where used, were obtained by dividing the series for the output of a sector by

1. The source of the original series for Australia and the States is A.B.S., *Quarterly Summary of Australian Statistics*, (Canberra), various issues, and the source of the seasonally adjusted series is A.B.S., *Seasonally Adjusted Indicators, 1973*, (Canberra), 1973.

the series for employment in that sector. Even this proved not to be as straightforward as envisaged and the problems faced and the series constructed will be discussed in section 4.4.

The final aspect of labour costs mentioned in the previous section of this chapter is overhead labour costs. In relation to this it was felt worthwhile to test as separate explanatory variables overhead and non-overhead labour costs. After examining the published time series, however, it appears that this will not be possible. The only source of data available is the A.B.S. surveys of wage rates, earnings and hours but data for these surveys are available only from 1963 onwards and only annual observations (at October of each year) are published. For these reasons the surveys have been disregarded as a source of data.

4.3.3 Materials Costs

As should be clear from the discussion in sub-section 4.3.1, there is a serious lack of quarterly price data in Australia. This was amply evident also in the search for materials prices, although in the area of materials price indexes the A.B.S. has started to remedy the situation by extending the number and scope of its materials price indexes. The outdated index "Wholesale Price (Basic Materials and Foodstuffs) Index" (hereafter denoted WPI) which ceased to be published after December 1970, is in the process of being replaced by the "Price Index of Materials used in Manufacturing" (which is yet to be published), the two building materials price indexes[1] and

1. The "Price Index of Materials used in House Building" and the "Price Index of Materials used in Building other than House Building".

the "Price Index of Metallic Materials". The indexes already published in this new series are, unfortunately, of limited use since the two building materials price indexes are available only from 1966-67 onwards and the remaining indexes from 1968-69. Apart from these indexes there are various indexes of unit values of primary products but these are, on the whole, available only at annual intervals and thus of little use. Hence all materials price indexes used in this study had to be constructed, the data used for this construction coming from various sources but mainly from the Export Price Index published by the A.B.S. and the Import Price Index published by the R.B.A. The methods used will be further discussed in section 4.4.

4.3.4 Sales Tax

Sales tax rate indexes are not available and had to be constructed from information published by the Commissioner of Taxation. Further discussion of these indexes will also be found in the following section.

4.3.5 Product Market Demand Variables

In the previous section six different types of product market demand variables were listed. Of these there are only two, namely (5) and (6) for which series are available or could be constructed from available data.

All output data had to be constructed or proxies used so that discussion of the output data will be deferred to the next section.

For sectors A1, ..., A7 the choice of expenditure data was straightforward since these sectors are defined by expenditure categories. Seasonally adjusted constant price estimates were used for type A sectors. The data used for sectors B1, ..., B6 and C1, ..., C6 had to be constructed and is therefore discussed in the next section.

4.3.6 Labour Market Demand Variables

The availability of data for the four types of labour market demand variables listed in section 4.2.6 will now be discussed. They are unemployment, vacancies, the Dow-Dicks-Mireaux index of excess demand in the labour market and overtime hours. Since the DDM index to be considered is the one developed for Australia by Hagger[1], the index for excess demand in the product market developed by Hagger and Rayner[2] will also be discussed here in conjunction with the series for the labour market although it should properly be included in the previous sub-section dealing with product market demand variables.

Consider, firstly, unemployment and vacancies. Both are available for Australia as a whole, for the States and for occupational groups.[3] Although vacancies are now published by the Department of

1. A.J. Hagger, "Excess Demand for Labour in Australia, 1948-63", *Economic Record,* 46, March 1970, pp. 26-54.

2. A.J.Hagger and P.J.Rayner, "Excess Demand for Commodities in Australia, 1950-51 to 1968-69", *Economic Record,* 49, June 1973, pp. 161-193. This article also contains more recent figures for the labour market index.

3. The source of statistics for both unemployment and vacancies is the Department of Labour, *Monthly Review of the Employment Situation,* (Melbourne), various issues with the exception that seasonally adjusted series for both aggregate unemployment and aggregate vacancies were obtained from A.B.S., *Seasonally Adjusted Indicators, 1973, op.cit.* The original series obtained from the Department of Labour publications were all seasonally adjusted by the ratio-to-trend method (see P.H.Karmel, *Applied Statistics for Economists,* (Melbourne: Sir Isaac Pitman & Sons, 1963), Ch.10).

Labour for industrial groups, these data are available only from July 1972 onwards and cannot, therefore, be used in the construction of sectoral data for sectors of type A and type B. The occupational groups for which both unemployment and vacancies are available are:

(1) Rural,

(2) Professional and semi-professional,

(3) Clerical and administrative,

(4) Skilled building and construction,

(5) Skilled metal and electrical,

(6) Other skilled, n.e.i.,

(7) Semi-skilled,

(8) Unskilled manual, and

(9) Service occupations.

With one exception, it is impossible even roughly to allocate these occupational groups to the final demand and consumer categories for which price determination equations are to be estimated. Hence it will be impossible to construct series for these types of sectors but unemployment and vacancies for Australia as a whole will be experimented with. The exception mentioned above is that vacancies and unemployment for occupational group (4) above could be used to represent the pressure of demand for sectors A3, A4 and B3 (the three building sectors). The use of vacancies or unemployment for this occupational group would omit any effect of the unemployment or vacancies of the semi-skilled and unskilled workers in the building industry on prices. Besides this consideration, the data for unemployment and vacancies for this occupational group are available only from 1962-63 onwards while data are required for the period 1959-60 onwards. For these reasons the series for unemployment and vacancies for the skilled building and construction occupational group were not used in the regressions.

For the geographical sectors C1, ..., C6 the figures for unemployment and vacancies for the States will be used. For unemployment the series to be used are those for "Persons registed for employment with the Commonwealth Employment Service" and following the precedent set by the RBA, the absolute numbers of unemployment and vacancies will be used.

Now consider the availability of data to represent overtime hours for the sectors to be used in this thesis. Only quarterly observations on factory overtime hours are available and they were obtained from Department of Labour publications.[1] The data available are disaggregated by industry and by State. Hence the required data are available for geographical sectors but not for consumer and expenditure sectors. Series for sectors of type A and type B will be constructed from the data available for industrial sectors and this will be discussed in more detail in the following section.

Finally, consider the two types of indexes calculated by Hagger and Hagger and Rayner. Both are available for Australia as a whole. The Hagger index for excess demand in the labour market is also available for the States separately but the Hagger-Rayner index is not. Neither are disaggregated in any other way. Hence it will not be possible to construct series of either type for type A and type B sectors and it will not be possible to construct product

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1. See Department of Labour, *op.cit.*

market series for geographical sectors. Besides these considerations, the data are unavailable for the full period 1959-60 to 1972-73 and thus could not be used in the equations to be estimated in this study. It would be interesting to experiment with these series using a truncated sample period especially so that their performance could be compared with the performance of more readily available series. However, this would not further the object of this study which is to estimate sectoral price equations for various Australian sectors for the period 1960-61 to 1972-73. These series were, therefore, not used in this study.

4.3.7 Unit Prime Costs

Since all the data needed to compute unit prime costs (UPC) using Agarwala and Goodson's input-output-based method are not available the data actually used are discussed in the following section. Briefly, data representing prices for industrial sectors are not available so that Agarwala and Goodson's original equation was used. The input-output and related coefficients were obtained from the 1962-63 input-output tables for Australia[1] but the 105 sector input-output matrix presented in these tables was aggregated to a 14 sector one because of the lack of labour cost and import cost data. Not all the data required for the conversion matrices for type A and type B sectors were available and some had to be constructed using suggestions provided by the Deputy Commonwealth Statistician, Hobart. Finally, the import cost data used was far from satisfactory and some arbitrary allocations of import prices to various aggregated input-

1. A.B.S., *Australian National Accounts - Input-Output Tables, 1962-63*, (Canberra), 1972.

output sectors had to be made.

4.4. Data Construction

This section will contain a discussion of the methods used to construct the required time series where these were not available in the proper form. Before getting down to the detail it may be helpful to explain a procedure which was used repeatedly to obtain the series required for the various type A and type B sectors.

Frequently where data were not available for type A and type B sectors they were available for industrial categories. Where this was the case the procedure used was to choose an industrial sector which was similar to the type A or type B sector for which the series was required and use the series for this industrial sector to represent the appropriate variable for the type A or type B sector in question. Alternatively, if there was no such industrial sector the procedure was to combine the series of several industrial sectors by means of weighted averages. This may be illustrated by the following example. Consider the expenditure sector A1, i.e., private final consumption expenditure, and assume that we wish to obtain a series representing the minimum wage-rate for this sector. As stated in the previous section, minimum weekly wage-rates are available for industrial and geographical sectors only. Since none of the industry groups for which wage-rates are available corresponds at all closely with expenditure sector A1, a weighted average of the series for the following groups was used:

(1) All manufacturing,

(2) Wholesale and retail trade,

(3) Public authority (n.e.i.) and community and business services, and

(4) Amusements, hotels and personal services.

The weights used were derived from the weights used by the A.B.S. in the calculation of the wage-rate indexes for all industry groups.[1] The groups included in the All manufacturing group are (a) Engineering, vehicles, etc., (b) Textiles, clothing and footwear, (c) Food, drink and tobacco, (d) Sawmilling, furniture, etc., (e) Paper, printing, etc., and (f) Other manufacturing. The minimum wage-rates for all these groups were chosen since it was difficult to exclude any one or more of them on the grounds that their wage-rate would not affect prices of consumer goods. The other groups chosen are obviously relevant to sector A1. It will be noted in the above and in what follows that the exclusion or inclusion of any one group is often somewhat arbitrary as it is bound to be if an industrial sector contributes to more than one type A or type B sector. In some cases it was impossible to make even a rough allocation of industrial category variables to type A or type B sectors. In these cases either the corresponding aggregate variable was used or the variable was excluded from the regression equation for the particular sector.

4.4.1 Labour Costs

In this section we will consider the minimum weekly wage-rate indexes used for sectors of type A, B and C and the data used to construct short-run productivity series for sectors of type A and B.

1. See A.B.S., *Labour Report, 1970,* (Canberra, 1971), p.97. The weights used for (1),(2),(3),(4) above were 0.7173, 0.2087, 0.0367, and 0.0373 respectively.

For reasons given below, short-run productivity series could not be constructed for geographical sectors.

Consider, firstly, the minimum weekly wage-rate indexes used for sectors A1, ... A7.[1] Where a weighted average of several indexes was used to give a minimum weekly wage rate index for a particular sector, the weights used were taken from the same source as in the example given above.

(a) For sector A1 we used a weighted average of the weekly wage-rate indexes for :

(1) All manufacturing,

(2) Wholesale and retail trade,

(3) Public authority (n.e.i.) and community and business services, and

(4) Amusements, hotels and personal services.

(b) For sector A2 the data used are identical to those used for sector A1.[2]

(c) For sectors A3 and A4 the index for the Building and Construction industry was used. It should be noted that both sector A3 and sector A4 are building and construction sectors, sector A3 covering dwellings and sector A4 other buildings and construction. The wage-rate indexes available do not make this

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1. The source of the data are A.B.S., *Monthly Bulletin of Employment Statistics*, (Canberra), various issues to 1962 and A.B.S., *Wage Rates and Earnings*, (Canberra), various issues after 1962.

2. This has been the practice for most of the explanatory variables, i.e., to use the same data for sectors A1 and A2. This was done becuase it was difficult to allocate any particular industrial category to the final government consumption expenditure sector and it was felt that in the absence of such an index the index derived for sector A1 was the most suitable alternative.

distinction so that the same index was used for both. This seems a suitable procedure since there is no obvious reason why employees working on dwellings should be paid a different minimum wage-rate than those working on other buildings.

(d) For sector A5 the index for the industrial group Engineering, metals, vehicles, etc., was used since this appeared to be the only industry resembling the investment in equipment sector.

(e) For sector A6 a weighted average of the indexes used for sectors A3 and A5 was used. This was done because sector A6 includes all public gross fixed capital expenditure and is not disaggregated into gross fixed capital expenditure on dwellings, other buildings and construction and equipment as is private gross fixed capital expenditure. Thus, in general, the data used for private consumption expenditure was also used for government consumption expenditure and a weighted average of the data used for the three private gross fixed capital expenditure sectors was used for the public gross fixed capital expenditure sector.

(f) For sector A7 the weighted index for all industry groups was used.

Consider now the data to be used for sectors B1, ..., B6. The following are the series used for type B sectors:

(a) For sector B1 a weighted average[1] of the minimum weekly

1. Where the series used to represent the minimum wage rate for a sector was a weighted average of the indexes for more than one industry group the weights used were derived from the same source as those used for the type A categories and were calculated in the same way. It will be noted in the following that for most type B sectors the index to be used is a weighted average of the index for the manufacturing sector (or sectors)

wage-rate indexes for the following two industrial sectors was used: (1) Food, drink and tobacco,

(2) Wholesale and retail trade.

(b) For sector B2 a weighted average of the indexes for the following two industrial sectors was used:

(1) Textiles, clothing and footwear,

(2) Wholesale and retail trade.

(c) For sector B3 the wage-rate index for the Building and Construction industry was used.

(d) For sector B4 a weighted average of the indexes for the following two industrial sectors was used :

(1) Sawmilling, furniture, etc.,

(2) Wholesale and retail trade.

(e) For sector B5 a weighted average of the indexes for the following three sectors was used:

(1) Engineering, metals, vehicles, etc.,

(2) Public authority (n.e.i.), community and business services,

(3) Amusements, hotels and personal services.

While the index for Engineering, metals, vehicles, etc., is obviously too broad for a consumer sector, it was nevertheless included because of the importance of the motoring item in the price index for sector B5.

(f) For sector B6 a weighted average of the following indexes was used: (1) The index calculated for sectors A1 above,

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corresponding to the consumer sector concerned and the index for the Wholesale and retail group, i.e., the index used attempts to take into account the wage cost in manufacturing and in the marketing of the commodities covered by the sector.

(2) The index for the Building and Construction industry.

The index for B6 is somewhat broader than the sum of those used for sectors B1, ..., B5. This index was used for B6 because, while it is difficult to allocate two of the indexes for manufacturing industries to any one of the consumer sectors, there appeared to be no reason why they should be excluded from the index for all consumer goods. The index for the Building and Construction industry was included in the index constructed for sector B6 and excluded from the index constructed for sector A1 because housing is included in the CPI but not in the final private consumption expenditure sector. In what follows this will be seen to be the general pattern, i.e., the index used or constructed for sector B6 is a weighted average of the series used or constructed for sectors A1 and A3.

Turn now to sectors C1, ..., C6. As mentioned in the previous section, minimum weekly wage-rate indexes are available separately for the States. However, since the price level in each State is to be represented by the CPI for the capital city of the State, the wage-rate indexes used were constructed so as to correspond as closely as possible to the dependent variable. Hence, for sectors C1, ..., C6, a weighted average of the indexes for each of the following industrial sectors for the State in question was used:

(1) All manufacturing,

(2) Building and construction,

(3) Wholesale and retail trade,

(4) Public authority (n.e.i.) and community and business services,

(5) Amusements, hotels and personal services.

It will be noted that these indexes are similar to the one used for sector B6. This was the reason for choosing a weighted average of these particular industrial sectors. The weights used are different for each State and are derived from the same source and calculated in the same way as those described above for type A sectors.

Finally, in this section on labour costs, we will consider the data used to represent productivity movements. Since there is no statistical information on productivity published on a sectoral basis, data on productivity, where used, were obtained by dividing output or production (these terms will be used interchangeably) of a sector by employment in that sector. Unfortunately, this was not as straightforward as envisaged at first. Firstly, where disaggregated data on output and employment are available, they are usually disaggregated on an industrial basis thus causing the same problems as were faced with the minimum wage-rate data discussed above. These problems were overcome in the same way as before, i.e., either by choosing an industrial sector which seemed reasonably close to the sector in question or by combining (by a weighted average) the series for more than one industrial sector in the case where more than one industrial sector appeared to correspond to part of the sector for which data are being sought. Secondly, although both production and employment, where available at a sectoral level, were both usually disaggregated on an industry basis, the actual industries for which each was available often did not correspond. Hence, sectoral productivity figures were used in the calculation of sectoral labour costs only for those sectors where industries for which employment figures were available and industries for which output figures were available appeared to correspond closely. For the sectors for which it was not possible to find closely corresponding employment and output data no short-run productivity series were calculated and ULC and ULCN variables could not be tested for these sectors. Thirdly, added to these difficulties was the fact that the employment and output categories chosen for a particular type A or type B sector did not always correspond to the wage-rate data chosen for that sector. Little could be done about this since, if productivity (and hence ULC and ULCN) had been computed only for those sectors where wage-rate, employment and output data correspond closely it would have been possible to test these variables for few, if any, sectors. In relation to this it should be noted that ULC and ULCN are also calculated using average weekly earnings as the numerator. For type A and type B sectors data for average weekly earnings for Australia as a whole were used and in this case there was no correspondence between the sectors covered in the numerator and those covered in the denominator of ULC and ULCN.

Let us now turn to a consideration of the data used to represent output for each sector. Generally, only factory production figures could be obtained and these were used. The A.B.S. publishes production statistics for various classes of goods[1] but these are all in terms of physical units which could not be combined to obtain production statistics for the sectors defined by type A and type B disaggregation. Hence, rather than using expenditure figures from

1. See, e.g., A.B.S., *Seasonally Adjusted Indicators, 1973, op.cit.*, pp. 34-52.

the National Accounts as proxies for production, the various ANZ Bank Indexes of Factory Production[1] were used for both type A and type B sectors with some exceptions to be noted below. Since quarterly production figures show marked seasonable variations which are unlikely to be reflected in price movements, seasonally adjusted figures were used.[2] Now consider the data used to represent output for type A sectors.

(a) For sector A1 a weighted average[3] of the ANZ Bank Indexes of factory production for the following industries was used:

(1) Furniture and furnishings,

(2) Textiles, clothing and footwear,

(3) Food, drink and tobacco,

(4) Gas, and

(5) Electricity.

When considering the reasons for including certain indexes

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1. These indexes were obtained from ANZ Bank, *Quarterly Survey*, various issues.

2. The *Quarterly Survey* contains seasonally adjusted as well as original indexes for broad commodity groups and original data only for the more disaggregated groups. Thus, a seasonally adjusted index as well as an original index is published for the Fuel and power group but only original data are published for the four Fuel and power sub-groups: P1 Coal and coke, P2 Gas, P3 Electricity, and P4 Petroleum products. Since the indexes for some of the sub-groups were used it was decided not to use any of the seasonally adjusted data published in the *Quarterly Surveys* but rather to take the original data even where seasonally adjusted data are available and to seasonally adjust them all by the same method, viz., the ratio-to-trend method mentioned above.

3. Where a weighted average of more than one series was used to represent output for any one sector, unless otherwise stated, the weights were derived from the weights used by the ANZ Bank to obtain the index for all groups. (For a description of the ANZ Bank Indexes and the weights used see the *Quarterly Survey* for October 1967.) It should be noted that weights are published only for the groups and not for the sub-groups. Where a weight for a sub-group was required the proportion of the weight of the group to which the sub-group belongs accounted for by the sub-group was calculated using data on Australian production obtained from the 1962-63 input-output tables.

and excluding others, it ought to be recalled that only indexes which had reasonably closely corresponding employment indexes were included. Hence Furniture and furnishings is only a sub-group of the Furniture and household goods group. The rest of this group was excluded because suitable corresponding employment series could not be obtained.

(b) Following the procedure outlined in the case of minimum wage-rates, the output index calculated for sector A1 was also used for sector A2.

(c) For Sector A3 there is no suitable production index vailable so that the number of new houses and flats completed was used.[1] This series was changed to an index with base 1966-67=100. This was done because the ANZ Bank data are all in the form of indexes and the wage-rate data are in the form of indexes. The employment data used which is to be described later was also changed to index form (base 1966-67=100). Thus all the data to be used in the calculation of ULC and ULCN is in index form and the resulting series for ULC and ULCN will also be in index form.

(d) For sector A4 the value of other buildings and construction completed[2] rather than the number completed was used since, while houses and flats may be sufficiently homogeneous for their number to be meaningful, this is not the case for other building and construction. Besides this consideration, the number of other building and construction completed is not published, probably for the above reason. Since the value

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1. The source of these data is A.B.S., *Building Statistics*, (Canberra), various issues.

2. Source as above for sector A3.

series reflects cost changes as well as quantity changes, the series was deflated by the implicit deflator for sector A4. Both the series used for A3 and the series used for A4 were seasonally adjusted by the ratio-to-trend method.

(e) For sector A5 a weighted average of the ANZ Bank indexes for the following groups was used:

(1) Metals, machinery and apparatus,

(2) Transport equipment,

(3) Chemicals and allied industries.

(f) Following the procedure used for sector A6 in the case of minimum wage-rates described above, a weighted average of the output indexes used for sectors A3, A4 and A5 was used for sector A6. The weights used for the three indexes were derived from the Australian production figures given in the input-output tables. Sector A3 was assumed to be equivalent to input-output sector E1 (Residential building), sector A4 was assumed to be equivalent to input-output sector E2 (Other building and construction) and sector A5 was assumed to be equivalent to the sum of the remaining sectors contributing to Private Gross Fixed Capital Expenditure. This was the same allocation used in the calculation of UPC series by the input-output method.

(g) For sector A7 seasonally adjusted non-farm product at constant prices was used to represent production.[1] This series was chosen to correspond to the total employment series which

1. Source of this series is A.B.S., *Quarterly Estimates of National Income and Expenditure,* (Canberra), various issues.

excludes employment in agriculture.

Now consider the data used to represent output for sectors B1, ..., B6.

(a) For sector B1 the ANZ production index for the Food, drink and tobacco industry was used.

(b) For sector B2 the index for the Textiles, clothing and footwear group was used.

(c) For sector B3 the index described above for sector A3 was used.

(d) For sector B4 we used a weighted average of the indexes for the following groups: (1) Furniture and furnishings,
(2) Gas, and
(3) Electricity.

The weights used were derived from the weights published by the ANZ Bank in the same way as described above for type A sectors.

(e) For sector B5 no suitable production data could be found for which corresponding employment data was available so that short-run productivity (and hence long-run productivity and ULC and ULCN) could not be calculated for this sector.

(f) Following the procedure used in the calculation of a minimum wage-rate index for sector B6, a weighted average of the production indexes calculated for sectors A1 and A3 was used to represent the production for sector B6. The weights used were those used for the construction of the CPI[1], the weight assigned to the index for sector A3 being the weight of the

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1. See A.B.S., *Labour Report, 1970*, (Canberra), 1971, pp. 34-40.

housing group in the CPI and the weight assigned to the index for sector A1 being the sum of weights for the other four groups.

Finally, in the case of production or output figures for the States (sectors C1, ..., C6) it was not possible to find suitable sectoral information. Firstly, in nearly all cases manufacturing production was available but only on an annual basis. Secondly, since the industrial disaggregation used above for sectors A1, ..., A7 and B1, ..., B6 is not available on a State basis, the output data which could be obtained for the States would not correspond very closely to the wage-rate data used. Thus it was decided not to test productivity, ULC and ULCN in the price equations to be estimated for the geographical sectors.

Consider now the second group of data required for the calculation of productivity series, viz., employment figures. As explained previously, both production and employment data were chosen so as to correspond as closely as possible. Hence for the sectors for which no suitable statistical information on production was available, employment data will be omitted in the lists below. The data used are based on the number of civilian employees published for industrial categories by the A.B.S.[1] Where the series used for a particular sector is a combination of the series for more than one industry the numbers employed in the various industries are added for each quarter and the resulting series is then changed to index form with base

1. The source of the data is A.B.S., *Employment and Unemployment*, (Canberra), various issues, except for data used for sectors A3, A4, B3 which were taken from A.B.S., *Building and Construction*, *op.cit.*

1966-67=100 for reasons discussed previously. Consider firstly, the data used for sectors A1, ..., A7.

(a) For sector A1 an index of the employment in the following industries was used:
(1) Furniture and fittings,
(2) Yarns and textiles,
(3) Clothing and knitted goods,
(4) Boots, shoes and accessories,
(5) Food, drink and tobacco, and
(6) Gas and electricity.

(b) For sector A2 the series calculated above for sector A1 was used.

(c) For sector A3 the series for Building and construction - houses and flats was used.

(d) For sector A4 the series for Building and construction - other was used.

(e) For sector A5 an index of the employment in the following industries was used:
(1) Founding, engineering, metal working,
(2) Ships, vehicles, etc.,
(3) Chemicals, dyes, explosives, paints, etc.

(f) For sector A6 a weighted average of the series for A3, A4 and A5 was used.

(g) For sector A7 an index of the total number of persons employed in all industry groups was used.

Now consider the employment data used for sectors defined by type B disaggregation.

(a) For sector B1 an index of the number employed in the Food, drink and tobacco industry group was used.

(b) For sector B2 an index of the number employed in the following industries was used: (1) Yarns and textiles,
(2) Clothing and knitted goods,
(3) Boots, shoes and accessories.

(c) For sector B3 the index calculated above for sector A3 was used.

(d) For sector B4 an index of the number employed in the following two industries was used: (1) Furniture and fittings, and
(2) Gas and electricity.

(e) For sector B6 a weighted average of the number employed in the two industries covered by sectors A1 and A3 was used.

4.4.2 Materials Costs

As noted in the previous section, data for materials costs are not readily available and the series used were constructed from data obtained from a variety of sources. The main sources of raw data were the Export Price Index (EPI)[1] and the Import Price Index (IPI).[1] Both of these indexes are disaggregated to some extent - both of them by commodity groups. It was also decided to link the two building materials indexes recently published by the A.B.S. to the building materials section of the WPI and to experiment with the linking of the "Price Index of Metallic Materials used in the Manufacture of Fabricated Metal Products" (part of the "Price Index of Metallic Materials") to the metals and coal section of the WPI as an alternative

1. The source of the EPI is A.B.S., *Quarterly Summary of Australian Statistics*, (Canberra), various issues; the source of the IPI is R.B.A., *Statistical Bulletin*, (Sydney), various issues.

to the use of the index to be constructed for sector A5.[1] The validity of the use of EPI, IPI and the three linked indexes will be further discussed in the next section of this chapter which is devoted to an evaluation of the data used.

Consider first the data used to represent materials costs for sectors defined by type A disaggregation.

(a) For sector A1 a weighted average of the indexes for the following EPI groups was used: (1) Wool,
(2) Meats,
(3) Dairy produce,
(4) Cereals,
(5) Dried and canned fruit,
(6) Sugar, and
(7) Hides and tallow.

The weights used were based on the input-output tables for 1962-63. This was felt to be preferable to deriving them from weights used by the A.B.S. to calculate the aggregate EPI since the latter are based on the composition of exports. One (and in one case two) input-output sector was allocated to each of (1) to (7) above. The value of the output of each of these input-output sectors which was absorbed by other Australian industries was then obtained from the input-output tables and the weight for any one sector was calculated as the proportion of its value of output absorbed by other Australian

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1. The two building materials price indexes and the "Price Index of Metallic Materials" are all published by the A.B.S. in mimeographed bulletins having the same title as the name of the index.

industries to the total for the sectors used.[1] The use of intermediate usage figures rather than total Australian production figures is felt to be preferable because it is likely that a large part of the output of the sectors used is exported and the resulting weights would not express the relative importance of the different materials prices for Australian producers.

(b) For sector A2 the index calculated above for sector A1 was used.

(c) For sector A3 the "Price Index of Materials used in House Building" linked to the building materials section of the WPI was used. The linked index was constructed firstly by changing the base of the building materials section of the WPI to that of the "Price Index of Materials used in House Building" and then joining the two indexes at the point for which the earliest observation on the new index was published. There did not appear to be any noticeable break in the linked series at the point of linkage.

(d) For sector A4 the "Price Index of Materials used in Building other than House Building" linked to the building materials section of the WPI was used. The two series were linked in that same way as those used for sector A3 and again there was no noticeable break in the linked index at the point of linkage.

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1. The input-output sectors allocated to (1) to (7) above are: (1) input-output sector A1, (2) input-output sector A4, (3) input-output sector A5, (4) input-output sectors A2 and A3, (5) input-output sector A7, (6) input-output sector C7, and (7) input-output sector C64. A list of the input-output sectors is contained in Appendix 4.1 to this chapter. It is felt that the weights thus derived for (5) and (7) are the least suitable as the correspondence between the input-output sectors and the indexes to which they are allocated is poor.

(e) For sector A5 it was intended to use the weighted average of the indexes for the following two IPI groups:

(1) Crude materials, inedible,

(2) Chemicals.

However, data for these two groups are available only from 1965-66 onwards, prior to which the disaggregation of the index is somewhat different although some classes in the old classification are similar to classes in the new classification.[1] There is, however, no equivalent for either (1) or (2) above so that it was decided to assume that (1) and (2) above combined (by a weighted average, the weights being derived from the weights used by the RBA in the calculation of the aggregate IPI) were equivalent to the indexes for (1) Basic materials and (2) Base metals combined in the old classification and these two combined indexes were linked in the same manner as the indexes for Sectors A3 and A4 were linked. As noted previously, another linked index (the metals and coal groups of the WPI linked to the "Price Index of Metallic Materials used in the Manufacture of Fabricated Metal Products") will be experimented with as an alternative to the linked IPI based index.

(f) For sector A6 the weighted average of the indexes derived for sectors A3, A4 and A5 will be used. The weights to be used are derived from the input-output tables and are the same as those used to weight the output series for sector A6 described

1. For a description of the change in the index see R.B.A., *Statistical Bulletin,* November 1969.

above. Since two alternative series are to be experimented with for sector A5 there will also be two alternative series for sector A6.

(g) For sector A7 the IPI was used to represent materials costs.

Consider now the materials cost data used in the equations for the consumer sectors.

(a) For sector B1 a weighted average of the indexes for the following EPI groups was used: (1) Meats,
(2) Dairy Produce,
(3) Cereals,
(4) Dried and canned fruit, and
(5) Sugar.

The weights used to combine these indexes were derived in the same way as those used to compute the materials cost index for sector A1.

(b) For sector B2 a weighted average of the indexes for the following two EPI groups was used: (1) Wool,
(2) Hides and tallow.

The weights were derived in the same way as those used for sector B1.

(c) For sector B3 the index calculated for sector A3 above was used.

(d) No series could be obtained or constructed for sectors B4 and B5 so that a materials price variable could not be tested for these sectors.

(e) As has been the practice in the construction of data for other variables for sector B6 a weighted average of the series calculated for sectors A1 and A3 was used for sector B6.

The weights used were derived by making the same allocations of input-output sectors to the groups combined in the series used for sector A1 and using the same value figures as were used in the derivation of the weights for that sector. The value of intermediate goods used by input-output sector E1 (residential building) was used as the value figure corresponding to the index for sector A3. Weights were then derived as for A1.

Finally, we must consider the case of sectors defined by geographical disaggregation. Here again we find a serious lack of published data for the States and rather than using no materials cost data at all for these sectors it was decided to use the index derived above for sector B6 in each of the equations for sectors C1, ..., C6 i.e., we will use an aggregate explanatory variable in these equations.

4.4.3 Sales Tax and Excise Rates

The sales tax variable will cover excise on beer, motor spirits and tobacco products as well as sales tax on other commodities. Sales tax is payable on goods only. All goods produced in Australia are subject to sales tax unless they are exempt. There is a general rate of 15% (currently) which is applied to a variety of goods not included in other classes. Besides the exempt class covered by the First Schedule there are three further classes covered by the Second, Third and Fifth Schedules of the Sales Tax (Exemptions and Classifications) Act 1953-73. To calculate a sales tax rate index for a particular sector the procedure was to decide which Schedule (or Schedules) applied to the sector and use the information available on changes in the rates of sales tax applicable to the goods covered by each Schedule[1] to calculate an index of the sales tax rate for that sector. No account was taken of goods being changed from one Schedule to another and the list of goods covered by each Schedule was taken as of March 1973. Where appropriate, account was also taken of changes in excise on beer, motor spirits and tobacco products. The information on excise changes was obtained mainly from the Budget Speech and papers of each year. Since information on changes in excise rates was difficult to obtain, a method similar to the one used by Higgins to calculate an index of the sales tax rate[2] was used to obtain an index of the change in total excise. The proportional change in the rate of excise was calculated as the ratio of the expected change in excise collections due to the new rate to the excise collections of the previous year. An index with base 1959-60=100 was calculated from these proportional changes. Similar indexes were also calculated for the rate of sales tax applicable to the goods covered by each of the Schedules mentioned previously. First consider the indexes used for type A disaggregation.

(a) For sector A1 a weighted average of the following indexes was used.

  (1) The index of the rate applicable to the goods covered by the Second Schedule,

  (2) The index of the rate applicable to the goods covered by the Third Schedule,

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1. See Commissioner of Taxation, *Sales Tax: Exemptions and Classifications*, (Canberra: Australian Government Publishing Service, 1971) and reprint pages to 1973.

2. See Higgins (1971b), *op.cit.*, p.27.

(3) The index of the rate applicable to the goods covered by the Fifth Schedule,

(4) The index of the general sales tax rate, and

(5) The index of the excise rate.

An average of these indexes was used for sector A1 because nearly all sales tax applies to consumer goods. The Second Schedule covers mainly "luxuries" such as jewelry, fur articles, cameras, television sets, etc., and also articles such as cosmetics, toilet articles, etc. Hence when we consider consumer sectors below the Second Schedule is allocated to sector B4. The Fifth Schedule covers automobiles and it is therefore allocated to sector B5 when consumer sectors are considered. The general rate also applies mainly to consumer goods.

(b) The output of sectors A2 to A6 is, on the whole covered by the First Schedule and therefore exempt from sales tax. Thus no sales tax or excise indexes were calculated for these sectors.

(c) For sector A7 the weighted average calculated for sector A1 was used.

The weights used to calculate the index for sector A1 and A7 were obtained as follows. It was decided to weight the sales tax indexes by weights derived from gross sale value of goods taxable at the various rates. These data are available from the Commissioner of Taxation.[1] Values for 1963-64 were used because this is the period nearest to the centre of the sample period for which the rates

1. See Commissioner of Taxation, *Taxation Statistics, 1963-64*, (Canberra).

applicable to the various Schedules were all different and the gross sale value data are dissected only by rates of tax and not according to the Schedule by which the taxable goods are covered. However, the gross sale value of the goods subject to excise is not published - only the total excise collections. Hence total excise and total sales tax were weighted by the value of excise and sales tax collections respectively for 1963-64.[1] The weight for total sales tax was then split up by gross sale value of taxable goods as described above.

Turning now to the sectors of type B the procedure adopted was as follows:

(a) For sectors B1 to B3 no index was used as the goods covered by these sectors are generally exempt from sales tax.

(b) For sector B4 a weighted average of the indexes for the rates applying to the goods covered by the Second and Third Schedules was used.

(c) For sector B5 a weighted average of the indexes for the rate of excise and the rate of sales tax applicable to goods covered by the Fifth Schedule was used.

(d) For sector B6 the index calculated for sector A1 was used.

The weights used for consumer sectors were derived in the same manner as those derived above for expenditure sectors.

Finally we have the sectors of type C. Since sales tax and excise are levied by the Commonwealth government, the index calculated above for sector A1 was used for all the sectors C1, ..., C6.

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1. Value of sales tax collected is available for total sales tax but is not disaggregated by rate.

4.4.4 Product Market Demand Variables

In this section dealing with product market demand variables, we will discuss the data used to represent expenditure for sectors B1, ..., B6 and sectors C1, ..., C6 and the data used to represent output for all sectors. Both expenditure and output data will be used to represent demand pressure in the product market and will be entered in the regression equations in the form of first differences. All expenditure data are taken from the same source as the data used to compute implicit deflators.[1]

For sectors B1, ..., B6 constant price quarterly estimates were not available for all sectors so that current price, seasonally adjusted estimates were used, these being deflated by the appropriate part of the CPI. The following data were used for sectors B1, ..., B6.

(a) For sector B1 data for consumption expenditure on food were used.

(b) For sector B2 data for consumption expenditure on clothing, footwear and drapery were used.

(c) For sector B3 the data used above for sector A3 were used.

(d) For sector B4 the data for consumption expenditure on household durables were used.

(e) For sector B5 the sum of expenditure on the following groups of consumption goods were used:

(1) Purchases of motor vehicles,

(2) Cigarettes, tobacco and alcoholic drinks, and

1. See A.B.S., *Quarterly Estimates of National Income and Expenditure, op.cit.*

(3) Other goods and services.

(f) For sector B6 the sum of total consumption expenditure and gross fixed capital expenditure on dwellings was used.

It can be seen that there is quite a close correspondence between the disaggregation of consumption expenditure and the groups for which the CPI is available.

There are no quarterly data on expenditure available for the States so that annual data for the States were used for sectors C1, ..., C6. It had been intended to use data for each State similar in coverage to the aggregate data used for sector B6. However, gross fixed capital expenditure on dwellings is not available for the States so that annual data for private final consumption expenditure were used.

Since output data have already been constructed for each sector for the calculation of short-run productivity[1], these data were used in the first difference form to represent demand pressure in the product market. Since output data were not constructed for sectors C1, ..., C6 the change in output variable will not be tested in the equations for these sectors.

4.4.5 Labour Market Demand Variables

In this subsection we have only to consider the construction of overtime hours data used for type A and type B sectors. As noted in the previous section, only factory overtime hours data are available and these were used. The published data are disaggregated by

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1. See above, sub-section 4.4.1.

industry and as with data discussed previously the approach used to obtain data for type A and type B sectors was either to use data for an industrial sector which appeared to correspond reasonably closely to the particular type A or type B sector in question or, if this was not possible, to use a weighted average of the data for more than one industrial sector. If neither of these solutions was possible and no data could be constructed for a particular sector the overtime hours variable was not tested for this sector. Where a weighted average of more than one series is used for a particular sector the weights are based on the average employment in the sectors for the year 1969-70. These employment data are obtained from the same survey from which overtime hours data were obtained.[1] It should be noted, however, that only about 90% of the factories supplying employment data also supply overtime data. The data are still preferable to the employment data obtained for industries from the A.B.S. since the industries for which these data are available differ somewhat from the industries for which the Department of Labour publishes overtime hours. First consider the data used for sectors A1, ..., A7.

(a) For sectors A1 and A2 a weighted average of the overtime hours worked in the following two industries was used:

(1) Clothing and textiles, and

(2) Food, drink and tobacco.

(b) For sectors A3 and A4 the series for overtime hours worked in the building and construction industry was used.

(c) For sector A5 a weighted average of the overtime hours worked in the following four industries was used:

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1. See Department of Labour, *Monthly Review of the Employment Situation, op.cit.*

(1) Basic metals,

(2) Transportation equipment,

(3) Other metal manufacturing, and

(4) Chemicals and allied products.

(d) For sector A6 a weighted average of the overtime hours worked in the industries used for sectors A3 and A5 was used.

(e) For sector A7 the series for total factory overtime hours was used.

Now consider the data used for sectors B1, ..., B6.

(a) For sector B1 the data for the food, drink and tobacco industry were used.

(b) For sector B2 the data for the clothing and textiles industry were used.

(c) For sector B3 the data for the building and construction industry were used.

(d) For sectors B4 and B5 no suitable data were available so that an overtime hours variable was not tested in the equations for these sectors.

(e) For sector B6 a weighted average of the overtime hours worked in the following industries was used:

(1) Food, drink and tobacco,

(2) Clothing and textiles, and

(3) Building and construction.

4.4.6 Unit Prime Costs

We will first consider the data to be used to generate the successive C vectors since these are the same for both disaggregation types A and B. It should be noted at this point that it was not possible to use the Agarwala and Goodson method to compute unit prime costs for geographical sectors. As has been noted previously, industrial prices are not available for Australia, centainly not for the sectors defined by the 1962-63 Input-Output Tables. Hence, the modification Agarwala and Goodson's initial equation suggested in the previous section[1] where the P vector was substituted for the C vector in equation (4.2) was not used. The Input-Output matrix for 1962-63 was used.[2] This matrix is a 105 sector matrix which will be substantially aggregated since, besides being computationally easier to use, the other data needed to compute unit prime costs are not available in nearly as detailed a disaggregation. The precise aggregation of the input-output matrix to be used will be more fully discussed below.

Both the ratio of wage costs/total costs and the ratio of import costs/total costs for each industrial sector can be derived from the industry by industry flow matrix contained in the input-output publication noted above. The ratio of wage costs to total costs for each sector will be represented by wages, salaries and supplements/(intermediate usage + wages, salaries and supplements + complementary imports c.i.f. + competing intermediate imports + duties on the two above items). The ratio of import costs to total costs will be represented by (complementary imports c.i.f. + competing intermediate imports + duty)/ denominator as above.

Regarding the time series required for unit labour costs and

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1. See p. 93, *supra*.
2. See A.B.S., *Australian National Accounts - Input-Output Tables, 1962-63, op.cit.*

unit import costs it was decided to aggregate the 105 input-output sectors so as to correspond as closely as possible to the industrial sectors for which minimum wage-rates which were used to represent unit labour costs are available and then to allocate import prices in a manner similar to the method used by Agarwala and Goodson.[1] Thus, the following aggregated input-output sectors were defined and the corresponding wage-rates were used:

(I) Input-output sectors A1, ..., A9.[2] This sector comprises agriculture, fishing and hunting. Unfortunately, no wage-rate index is available for this sector so that the index for the Food, Drink and Tobacco industry was used.

(II) Input-output sectors B1, ..., B4. The wage-rate index to be used for this sector is the index for mining and quarrying.[3]

(III) Input-output sectors C1, ..., C13. The wage-rate for this sector is to be represented by the index for food, drink and tobacco manufacturing.

(IV) Input-output sectors C14, ..., C22. The wage-rate for this sector is to be represented by the index for textiles, clothing and footwear.

(V) Input-output sectors C23, ..., C27. The wage-rate for this sector is to be represented by the index for sawmilling, furniture, etc.

(VI) Input-output sectors C28, ..., C30. The wage-rate for this sector is to be represented by the index for paper, printing, etc.

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1. See Agarwala and Goodson, *op.cit.*, p.61.
2. A list of the 105 sectors distinguished in the Input-Output Tables will be found in Appendix 4.1 to this chapter.
3. For the source of the wage-rate data see above, sub-section 4.4.1.

(VII) Input-output sectors C31, ..., C42, C57, ..., C69. The wage-rate for this sector is to be represented by the index for other manufacturing.

(VIII) Input-output sectors C43, ..., C57. The wage-rate for this sector is to be represented by the index for engineering, metals, vehicles, etc.

(IX) Input-output sectors D1, ..., D3, I1, ..., K3. The wage-rate for this sector is to be represented by the index for public authorities,n.e.i. and community and business services.

(X) Input-output sectors E1, E2. The wage-rate for this sector is to be represented by the index for building and construction.

(XI) Input-output sectors F1, ..., F3. The wage-rate for this sector is to be represented by the index for wholesale and retail trade.

(XII) Input-output sector G1. The wage-rate for this sector is to be represented by the index for road and air transport.

(XIII) Input-output sectors H1. The wage-rate for this sector is to be represented by the index for communication.

(XIV) Input-output sectors L1, ..., N1. The wage-rate for this sector is to be represented by the index for amusements, hotels, personal services, etc.

Thus, aggregating the input-output matrix in this way we obtain a 14 x 14 input-output matrix.

Various sections of the RBA Import Price Index were allocated to the 14 sectors of the aggregated input-output matrix as follows:

(I) Machinery prices.

(II) Machinery prices. For both sectors I and II imports are not very significant.

(III) Food, beverages and tobacco.

(IV) Textiles.

(V) The index calculated above for crude materials, inedible and chemicals.

(VI) The index calculated above for crude materials, inedible and chemicals.

(VII) The index calculated above for crude materials, inedible and chemicals.

(VIII) The index calculated above for crude materials, inedible and chemicals.

(IX) Imports are insignificant and no suitable index is available.

(X) Imports are insigifnicant and no suitable index is available.

(XI) Imports are insignificant and no suitable index is available.

(XII) Transportation equipment.

(XIII) Electrical machinery.

(XIV) Imports for this sector appear significant from the information given in the input-output tables but no suitable data are available so none were used.

To enable us to compute the elements of both the conversion matrices, we need a more complete breakdown of the final demand section of the industry by industry flow matrix of the Input-output tables so that the columns are expanded to the following:

1. Consumption expenditure - food,
2. Consumption expenditure - clothing and textiles,
3. Consumption expenditure - household supplies and equipment,

4. Consumption expenditure - miscellaneous,
5. Consumption expenditure - public,
6. Gross fixed capital expenditure - dwellings,
7. Gross fixed capital expenditure - other building and construction,
8. Gross fixed capital expenditure - all other, and
9. Gross fixed capital expenditure - public.

A request was made to the A.B.S. for this additional information and although they could not supply a complete reconciliation of the input-output industries with the CPI groups (1 to 4 above), they suggested a method of allocating the whole of the final demand figures of each of the 105 input-output industries to the classes 1 to 9 listed above. Firstly, sectors A1, A2 and A6 have corresponding columns in the final demand section of the input-output tables. Secondly, the final demand section of the tables had 6, 7 and 8 above aggregated under one heading of "Private gross fixed capital expenditure" and the figures in this column had to be allocated to one of 6, 7 or 8. This was straightforward since the input-output sector E1 corresponds to 6 above, input-output sector E2 corresponds to 7 above, and the remaining figures in the column for Private gross fixed capital expenditure were allocated to 8 above. Thirdly, the figures in the column for Private consumption expenditure were allocated to one of 1, 2, 3 or 4 above by following the guide provided by the A.B.S. The contribution to final demand of the following input-output sectors was allocated to 1 to 4 respectively.

(1) The contribution to final demand of the following input-output sectors was allocated to the food group 1 above: A1, A4, A5, A6, A7, C1, C2, C3, C4, C5, C6, C7, C8, C9, C10.

(2) The contribution to final demand of the following input-output sectors was allocated to 2 above: C20, C21, C22.

(3) The contribution to final demand of the following input-output sectors was allocated to 3 above: A8, B2, C16, C18, C25, C30, C35, C36, C37, C39, C49, C51, C59, C60, C67, C69, D1, D2.

(4) The contribution to final demand of the following input-output sectors was allocated to 4 above: C11, C13, C29, C38, C66, F3, G1, H1, I2, L1, L2.

After these allocations were made the input-output sectors were aggregated as described above.

4.5 Evaluation of the data

This section will contain an assessment of the statistical information described in the previous section. Where appropriate, the data will be examined in two ways: firstly, we will consider how reliable the data series are in themselves and secondly, we will consider how well the series measure the variables they are to be used to measure. The order of the discussion in this section will be the same as that in the previous three sections.

4.5.1 Prices (dependent variable)

The implicit deflators to be used to represent prices for the expenditure sectors were derived by dividing current price estimates of expenditure for each sector by the corresponding constant price estimates. The Commonwealth Statistician states that

> "... in concept, constant price estimates may be thought of as being derived by expressing the value of every component

> commodity as the product of a price and a quantity, and by substituting for each actual current price the corresponding price in the chosen base year. Aggregates at constant prices for each year are then obtained by summation."[1]

Thus, the index obtained by dividing the current price by the constant price estimates should be a price index with current-period weights. However, the "ideal" method of calculating constant price estimates (and hence implicit deflators) described above is not always used where data required for such calculations are unavailable. Hence in some cases current prices estimates are revalued by independently constructed price indexes which ought to provide the same results as the "ideal" method if the price index used is a current-weight one which, however, is not always the case, e.g., where components of the CPI are used. Another method used to obtain constant price estimates is by the use of implicit price indexes. In this case an implicit deflator as described above is obtained for those components of an aggregate for which direct revaluation is possible and this implicit deflator is then applied to those components for which direct revaluation is impossible. It would appear that this last method is the least satisfactory but it is used in only a small number of cases.[2]

Thus, while the implicit deflators obtained from the National Accounts and used to represent prices for expenditure sectors are largely a mixture of current-weight and base-weight indexes, they would appear to be reasonably reliable measures of price changes.

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1. A.B.S., *Australian National Accounts, 1971-71,* (Canberra, April 1973), pp. 15, 16.

2. *Ibid.*, Appendix B, pp. 105-107.

Since the expenditure sectors were chosen on the basis of available implicit deflators, the implicit deflators and the sectors for which they are used are well matched.

The prices for the consumer goods sectors are measured by components of the CPI and since the consumer sectors used in this thesis were defined to correspond to the components of the CPI available, the price measures used correspond to the sectors chosen. Secondly, the CPI itself reliably measures price changes of the goods and services it covers which represent "a high proportion of the expenditure of wage-earner households".[1]

The prices for geographical sectors are somewhat less satisfactory than the prices for the previous two types of sectors. This is because consumer prices were used to represent all prices in each State. Secondly, the consumer prices measured for each geographical sector represent only prices in the capital city of each State. It is felt that the first defect is worse than the second, i.e., it is more likely than consumer prices in various parts of any one State will move in a manner similar to the prices in the capital city of the State than that prices of non-consumer goods move in a manner similar to the prices of consumer goods. However, the fact that consumer prices were used was taken into consideration when data measuring explanatory variables were chosen.

4.5.2 Labour costs

Under this heading we will consider four different types of

1. A.B.S., *Labour Report, 1970*, (Canberra, 1971), p.7.

series, viz., minimum weekly wage-rates, average weekly earnings, production or output and employment.

Some mention has already been made of the difficulties involved in using minimum weekly wage-rates as a basis for the computation of ULC or ULCN. Some further disadvantages of using these data are that only wages are covered and therefore salaries are excluded making the measure narrower than the aggregate measure used successfully in the RBA and T-ABS studies for Australia. These studies based their ULC and ULCN series on "non-farm wages salaries and supplements". Secondly, the wage-rate for each industry is based on a weighted average of wages for several representative occupations in each industry, the weights being based on surveys carried out in 1954 and thus possibly being outdated especially for the latter part of the sample period. But, as stated previously, since minimum wage-rates are the only quarterly labour cost data vailable for industries they were nevertheless experimented with.

The use of average weekly earnings data overcame some of the difficulties associated with the use of wage-rates in that they cover a far greater number of items entering into labour costs. In fact,

> "... the earnings figures used in the calculation of averages comprise award and over-award wages and salaries, the earnings of employees not covered by awards, overtime earnings, bonuses and allowances, commissions, directors' fees and payments made retrospectively or in advance during the quarter."[1]

However, as stated above, these data are not available on an industrial basis so that aggregate earnings variables were used in equations

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1. A.B.S., *Wage Rates and Earnings, December 1973*, (Canberra).

for sectors of type A and type B. Unfortunately, there is a break in the comparability of the series between the June 1966 quarter and the September 1966 quarter but since there was no way in which this could be rectified it was ignored.

The third type of series to be considered here is the series used to represent output or production in the calculation of labour productivity. Consider first the A.N.Z. production indexes used. The Index is based on (1) data published by the A.B.S., (2) Unpublished data from the A.B.S., and (3) data available only to the Bank from a number of companies and other sources. In this sense the indexes used, where factory production is concerned, are more comprehensive than data published by the A.B.S. However, the coverage of various groups varies from 22% (Miscellaneous) to 100% (Fuel and Power), the coverage for most groups being between 65% and 85% which, while not perfect, appears to be satisfactory although it should be noted that the coverage is only in relation to factory production. One problem encountered in the use of these indexes was that in 1967 all indexes were rebased on the base 1963-64. Some changes were incorporated in the series when the base was changed and indexes with the new base were published only from January 1963 onwards. Since data were collected for this study for the period 1959-60 to 1972-73 data for periods prior to 1963 were calculated on the assumption that the series published with base 1958-59 were comparable to the series published with base 1963-64 and the data for 1959-60 to 1962 were converted to base 1963-64 by dividing by the figure for 1963-64 with base 1958-59.

The crudeness with which the indexes approximate production for the sectors used in this study is likely to be more serious than the imperfect quality of the series themselves. As can be seen from a comparison of the indexes used with the series required for each sector, in many cases only a part of the output of a certain sector was covered by the index used and in some cases a broader index than was appropriate was used. This problem was aggravated by the fact that the production indexes were chosen only where a corresponding employment series was available. Much of the lack of correspondence between production series and the sector for which the series was used was due to the fact that the aggregate Index was disaggregated on an industrial basis whereas the sectors used in this study were defined by class of expenditures, class of consumer good and State.

Besides the A.N.Z. production indexes other measures of output were used. For sector A3 (Private Gross Fixed Capital Expenditure: Dwellings) the number of houses and flats completed in the quarter was used to measure output. The use of this series was felt to be preferable to the use of the A.N.Z. index for Building Materials since it more closely corresponds to the sector. The number rather than the value of new houses and flats completed was used to eliminate the effect of price changes. The weakness of the series is that because the production of houses and flats is far from instantaneous, some of the houses and flats completed in any one quarter are likely to have been commenced in the previous quarter so that the number of houses and flats completed in any one quarter is not a true measure of the "output" of the sector for that quarter. However, it is felt that this difficulty will not be too serious provided the output of the housing sector does not fluctuate too widely. For sector A4 (Private Gross Fixed Capital Expenditure: Other Building and Construction) the value of other new building and construction completed deflated by the implicit deflator for sector A4 was used to represent output. Finally, for sector A7 the series for non-farm product at constant prices was used to represent output. This series was chosen as the widest constant price series published which corresponded to the total employment series. Apart from consideration of the nature of the employment statistics used, farm production is probably best excluded from total output data because it is strongly influenced by exogenous factors causing production to fluctuate widely and the resulting fluctuations in productivity are unlikely to be reflected in prices especially because prices are not usually "fixed" by farmers.

Finally, in this section on labour costs, consider the employment data used in the calculation of productivity. The employment series used were obtained from A.B.S. publications. The A.B.S. produces estimates of employees by industries on the basis of pay-roll tax and other returns which in 1966

> "... accounted for about 85% of the total number of employees in the industries covered." [1]

Hence the coverage is satisfactory. The data exclude employers, self-employed persons and unpaid helpers but this is not likely to seriously affect the data. As with some other series, there is a break in the continuity of the employment series at June 1966 but

1. A.B.S., *Employment and Unemployment, op.cit.* p.2.

since this could not be overcome it was ignored.

As in the case of production indexes, the lack of correspondence between the series and the sectors for which they are used is likely to be a greater cause for concern than any defects in the series themselves and as a result of this the regression results to be presented in later chapters cannot hope to provide definite answers to questions posed about the importance of productivity movements in the pricing process.

4.5.3 Materials cost

As mentioned above, the use of the materials price data proposed in the previous section is not very satisfactory but they were used because of the lack of more satisfactory data. It was proposed to use mainly components of the Export Price Index and the Import Price Index (subsequently referred to as the EPI and IPI respectively). As an alternative approach to the use of these indexes and wage-rate or earnings indexes it was suggested that Agarwala and Goodson's input-output method of computing unit prime cost ought to be experimented with.

Consider, first, the use of the components of the IPI. The RBA Import Price Index is reasonably comprehensive although

> "... in many instances one indicator
> is assumed to measure price movements
> for a number of similar commodities."[1]

A more serious weakness in the series used for this study is caused by the change in classification incorporated when the series was

1. Reserve Bank of Australia, *Statistical Bulletin*, November 1969, 141.

rebased to 1966-67=100. Series using the new base were calculated only back to 1964-65 so that the old series for periods prior to 1964-65 had to be linked to the new series to provide data for the entire proposed sample period. All except two of the groups in the new classification used in this study had counterparts in the old classification and price indexes for these groups were linked to their counterparts. The Bank states that these groups

> "... suffered a change in composition but are otherwise comparable with similar groups in the 1962-63 based index." [1]

The break in continuity of these series does not appear very serious especially since they were linked at 1966-67 rather than 1965-66. The exceptions mentioned above are the Crude Materials, inedible and the Chemicals groups in the new classification which have no counterpart in the old classification. As explained in the previous section this problem was overcome by assuming that these two groups combined are comparable to the two groups Basic Materials and Base Metals in the old classification combined so that these two combined series were linked. It was decided to use this somewhat questionable approximation since this provides one of the few raw materials indexes available.

The problems arising out of the imperfections of the IPI as such do not appear to be as serious as those arising from the use of import prices as proxies for materials prices. The use of import prices for a particular sector would appear justified where import prices, in fact, represent the prices of materials used by that sector. They would also probably be suitable as a measure of materials prices

1. *Ibid.*

where the particular sector for which they are used uses materials inputs which are imported as well as produced within Australia and the prices of imported materials and home-produced materials move in a similar way. However, import prices are too narrow a measure of materials prices although this restriction is eased somewhat by the use of components of the EPI and some other price indexes. Despite the use of additional price indexes, it will be difficult to draw any strong conclusions concerning the importance of materials prices in the pricing process from the results obtained using import prices. A further difficulty in the interpretation of the results using components of the IPI is caused by the possibility that included in the regimen of a particular component of the IPI are goods also produced by the sector for which the component is being used so that a positive coefficient in a regression equation would be expected on the basis of similar movements of the prices of competing goods rather than on the basis of the importance of materials prices in the pricing process.

Hence regarding the components of the IPI, the components to be used appear to be quite satisfactory measures of import prices with the exception of the series which had to be combined and linked in a rather primitive fashion. The use of the series to measure materials prices does not appear to be very satisfactory and this will have to be taken into account when the regression results are interpreted. Consider now the components of the EPI to be used.

The weights and composition of the EPI was originally based on the pattern of exports in the years 1956-57 to 1960-61. After some years the coverage of the index declined markedly and a review of the index was undertaken with the result that an interim series was published from 1969 onwards linked to the old index at July 1969 and based on the composition of exports for 1969-70. This has caused some discontinuity at the point of linkage. Since in some cases this break in the series is quite marked, it will have to be kept in mind when the regression results are evaluated. Apart from this problem the series appears quite satisfactory. The variation in the coverage of the EPI as a whole over the sample period should be no cause for concern since in this study we are only using the components of the index as proxies for the prices of materials used by Australian producers rather than the EPI as a whole to measure changes in export prices.

Now consider the appropriateness of the components of the EPI as measures of materials prices in this study. The index is used mainly where it is felt that Australian producers use inputs which are also exported (e.g., wool) and that Australian producers pay the same prices as overseas buyers. If this is the case in the sectors for which export prices are used as a proxy for materials prices then the components of the EPI used appear appropriate especially since they are based on prices measured f.o.b. at the Australian port of export.[1] However, there is the danger in some cases that the component of the index used for a particular sector also measures the price of the output of the sector in which case a significant positive regression coefficient would be expected but this would tell us nothing about the importance of materials costs in the pricing process.

1. See A.B.S., *Year Book of Australia, 1973*, (Canberra), pp. 240-242.

Apart from the IPI and the EPI, three other series were used as measures of materials prices for some sectors. Two of these involved the linking of the Building Materials section of the discontinued WPI to the two Building Materials prices indexes available from the A.B.S. since 1966-67. This procedure was necessary since the two new building materials price indexes are not available for the entire sample period. The obvious weakness of the procedure is that the WPI was discontinued because it was out of date and the validity of linking part of it to more up to date indexes is questionable. This is apparent when the weights of the two new indexes are compared to the weights of the old index. There are some similarities between the weights of the Building Materials section of the WPI and the weights of the Price Index of Materials used in House Building but few between the weights of the WPI Building Materials section and those of the Price Index of Materials used in Building other than House Building. Thus, as with other material price indexes, the regression results will have to be interpreted with these weaknesses in mind.

The remaining series to be considered is another linked series which links the index for the Metals and Coal group of the WPI to the Index of Metallic Materials used in the Manufacture of Fabricated Metal Products (subsequently referred to as the PMP). The weaknesses of this linked series are similar to those described above concerning the building materials indexes, i.e., the WPI is out of date and it seems unsatisfactory to link it to an up to date index and secondly, the items covered and the weights of the two indexes differ substantially especially since the PMP does not cover coal which has a weight of 64% in the Metals and Coal section of the WPI. Hence the same caution will have to be used in the interpretation of the regression results.

Thus, on the whole, the data used in this study to represent materials prices are not very satisfactory. This is because there is no unified set of materials price indexes available for Australia so that the data used had to be obtained from various different sources. The data used was often of a type not designed for use as materials prices. Added to this difficulty was that during the sample period the A.B.S. ceased to publish the WPI which had become outdated and since 1966-67 has been in the process of replacing it by the "Price Index of Materials used in Manufacturing".

4.5.4 Sales Tax and Excise

Although the sales tax data used are accurate since the rates are published by the Commissioner of Taxation, the goods grouped under the various Schedules do not correspond very closely to the sectors used in this thesis since they are, obviously, not grouped for statistical purposes. Thus for each sector the sales tax series used (where applicable) was a weighted average of the rates applied to the goods included in that sector, the weights being based on the gross sales value of goods taxable at various rates. The weights were based on data published by the Commissioner of Taxation for 1963-64.[1] This year was chosen as the year closest to the middle of the sample period in which the rates of sales tax applicable under the various Schedules were all different. This was necessary because the dissection of gross sales value of taxable goods was by rate of tax and not by

1. See Commissioner of Taxation, *Taxation Statistics,1963-64*, Supplement to the Forty-third Report to Parliament of the Commissioner of Taxation, (Canberra).

Schedule.

The calculation of an index measuring changes in excise duties was more difficult since the information was obtained from the Budget Speech but was insufficient to calculate the percentage increase in excise duties for each year of the sample period. In general, where an increase in excise is proposed in the Budget, the increase in revenue estimated to result from the increase in excise duties is given and this figure was divided by the excise collections for the previous year to obtain an estimate of the percentage increase in the "rate" of excise. This approach, which was used by Higgins to obtain an index for the rate of sales tax,[1] is based on the assumption that the estimates are calculated by the Treasury under the assumption that a change in excise will not significantly affect the quantity of goods sold. The series so derived will be inaccurate to the extent that this assumption is invalid.

4.5.5 Product Market Demand Variables

In this subsection we will consider the use of output and expenditure data to represent the pressure of demand in the product market.

The output data used is the same as those used to calculate output/man and is thus subject to the same limitations. Output data will be used in the form of the change in output. The use of the change in output to represent the pressure of demand in the product market is based on the reasoning that an increase (decrease) in demand will bring about an increase (decrease) in output. It is

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1. See Higgins, *op.cit.*, p.27.

possible that this variable should enter a price equation with a lag since it may take an increase in demand persisting over several periods to bring about an increase in output and a fall in demand may need to persist for several periods before producers will cut production.

The expenditure data for sectors A1, ..., A7 is satisfactory since constant price estimates of expenditure are available for each sector and these estimates will be seasonally adjusted. For sectors B1, ..., B6 the expenditure data are from the same source but do not match the sectors as well. This is disadvantageous for two reasons: firstly, the expenditure variable will not closely match the sector for which the dependent variable is defined; secondly, the components of the CPI used to deflate the expenditure data will not closely match the data being deflated. However, the mis-matching will not be as serious as for some other variables, e.g., output, wages. The expenditure data used for the States has the weakness that, because only annual data are available, the annual level of expenditure in each State had to be assumed to hold for each quarter.

4.5.6. Labour Market Demand Variables

Now consider the four labour market demand variables to be used as proxies for the pressure of demand in the product market.

The most widely used measures of demand pressure in the labour market in Australia are the number of unemployed and the number of vacancies or some combination of these variables. Both original and seasonally adjusted series will be used in this study although it is likely that the seasonally adjusted series will perform more satisfactorily in regression equations since it is unlikely that producers will vary prices in response to changes in demand which are known to be of a seasonal nature only. Unfortunately, unemployment and vacancy series are not available for industrial, consumer or expenditure sectors so that for the type A and type B sectors the aggregate number of vacancies or the aggregate number of unemployed had to be used. Hence it will be difficult to draw conclusions regarding the importance of sectoral demand pressure from regression equations using these data.

The data for overtime hours used was more satisfactory in that it was available for industrial sectors. However, the data have several weaknesses. Firstly, only factory overtime hours are available. Secondly, as with most data obtained from an industrial disaggregation difficulties were experienced in matching industrial sectors and sectors of type A and type B. In fact for two sectors of type B no suitable data could be obtained.

4.5.7 Unit Prime Costs

As an alternative to the use of materials prices and wage costs as described above, it was proposed to experiment with the input-output method for computing unit prime costs used by Agarwala and Goodson in their study of prices for the U.K. As explained in section 4.4, the modification of Agarwala and Goodson's initial equation suggested in section 4.3 was not possible so that their less satisfactory initial equation had to be used. The common criticism of the input-output assumption of constant coefficients for the sample period may also be made in this case especially since the input-output data used relate to 1962-63 which is in the beginning of the sample period so that we cannot assume that the coefficients used represent the average for the period. However, since the most recent input-output tables for Australia relate to 1962-63, no alternative was available. Both the measures used for the ratio of labour costs to total costs and the ratio of import costs to total costs appear satisfactory since all the data needed for their calculation were available from the input-output tables. This was not the case for the elements of the conversion matrix. The elements corresponding to three type A sectors were calculated directly from the tables, viz., those for sectors A1, A2, A6. The elements for the remaining sectors could not be calculated until the final demand columns of the input-output table had been dissected to correspond to the sectors to be used in this study. Firstly, the figures in the column for Gross Fixed Capital Expenditure - Private had to be allocated to one of the groups: (1) Gross Fixed Capital Expenditure - Dwellings, (2) Private Gross Fixed Capital Expenditure - Other Building and Construction, and (3) Private Gross Fixed Capital Expenditure - Other. The allocation used should be satisfactory since input-output sector E1 (Residential Building) corresponds to (1) above and input-output sector E2 (Other Building and Construction) corresponds to (2) above with the remaining figures in the column for Private Gross Fixed Capital Expenditure being allocated to group (3). The allocation of figures for Current Expenditure - Personal Consumption to the five sectors B1, ..., B5 (i.e., corresponding to the CPI groups) was a little less straightforward but, using the guide for allocation provided by the Commonwealth Statistician, the resulting figures are felt to be reasonably close to those which would have been obtained if a proper reconciliation between the groups of the CPI and the input-output sectors had been carried out. It should be noted that not all industries contributing to the Current Expenditure - Personal Consumption column of the input-output tables produce goods covered by the CPI. In fact, if the output of the input-output sectors is allocated to the CPI groups as suggested by the Commonwealth Statistician then 13.71% of Current Expenditure - Personal Consumption is not covered by any of the CPI groups. However, this will not affect the validity of the results obtained using this method since the elements of the conversion matrix are designed to show the proportions of the commodities covered by each CPI group derived from the various input-output sectors. It does mean that the coverage of the CPI is narrower than the implicit deflator for Current Expenditure - Personal Consumption. (sector A1).

Discussion of the wage-rate and import cost data used will be brief since these have been discussed previously. An additional weakness of the wage-rate data is that they do not match the ratios of labour costs to total costs very closely since minimum wage-rates are used and the numerator (and denominator) of the ratio of labour costs to total costs also includes salaries and supplements. Another unsatisfactory aspect of the wage-rate data used is that no wage-rate index is available for (aggregate) input-output sector I (Agriculture) so that the index for the Food, Drink and Tobacco industry was used to represent wage costs for this sector. Apart from the quality of the import cost data used, the allocation of indexes to the input-output sectors is clearly unsatisfactory but given the data available this is difficult to improve upon.

APPENDIX 4.1

Below is a list of the 105 industrial sectors of the Australian Input-Output Tables which have been aggregated to obtain the 14 sectors to be used in this thesis.

A1 Sheep
A2 Wheat
A3 Other grains
A4 Meat cattle
A5 Milk cattle and pigs
A6 Poultry
A7 Other crops
A8 Forestry and logging
A9 Fishing and hunting
B1 Metallic minerals
B2 Coal and crude petroleum
B3 Other non-metallic minerals n.e.c.
C1 Meat and fish products
C2 Milk products
C3 Fruit and vegetable products
C4 Margarine, oils and fats
C5 Flour mill and cereal food products
C6 Bread, cakes and biscuits
C7 Sugar
C8 Confectionary and cocoa products
C9 Food products n.e.c.
C10 Soft drinks, cordials and syrups
C11 Beer and malt
C12 Other Alcoholic beverages
C13 Tobacco products
C14 Prepared fibres
C15 Yarns and rope
C16 Woven piece goods, carpets and felt
C17 Textile finishing
C18 Blinds, mattresses and household textiles
C19 Other textile products
C20 Knitting mills
C21 Clothing
C22 Footwear n.e.c.
C23 Saw-mill products
C24 Manufactures board and joinery
C25 Wooden furniture
C26 Pulp, paper and paperboard
C27 Fibreboard and paper containers
C28 Paper products n.e.c.
C29 Newspapers and books
C30 General printing and stationery

C31 Fertilisers and industrial chemicals
C32 Industrial gases and other chemical products
C33 Arms, ammunition and explosives
C34 Paints
C35 Pharmaceutical and toilet preparations
C36 Soap and other detergents
C37 Inks, polishes, adhesives, etc.
C38 Petroleum products
C39 Glass and glass products
C40 Clay products
C41 Cement and concrete products
C42 Other non-metallic mineral products
C43 Iron and steel
C44 Ferrous foundry and engineering products
C45 Non-ferrous metal smelting and refining
C46 Non-ferrous metal rolling
C47 Fabricated structural metal products
C48 Metal containers
C49 Metal furniture
C50 Other metal products
C51 Cutlery and hand tools
C52 Wire products
C53 Hardware and plumbing equipment
C54 Motor vehicles and parts
C55 Ship and boat building and repair
C56 Locomotives, rolling stock and repair
C57 Aircraft building and repair
C58 Medical, photographic etc. equipment
C59 T.V., radios, electronic equipment, n.e.c.
C60 Household appliances n.e.c.
C61 Electric Cable, machinery, equipment n.e.c.
C62 Agricultural machinery and equipment
C63 Other industrial machinery and equipment
C64 Leather tanning
C65 Leather and substitute products n.e.c.
C66 Rubber products (including retreading)
C67 Plastic materials and products
C68 Toys and sporting equipment
C69 Writing and marking equipment
D1 Electricity
D2 Gas
D3 Water, sewerage and drainage
E1 Residential building
E2 Other building and construction
F1 Wholesale trade
F2 Retail trade
F3 Motor vehicle repair and service
G1 Transport and storage
H1 Communication
I1 Finance and life insurance
I2 Other insurance
I3 Investment and real estate

I4	Business services
J1	Public administration
J2	Defence
K1	Health
K2	Education
K3	Welfare and religious institutions
L1	Entertainment and hotels
L2	Other personal services
M1	Ownership of dwellings
N1	Miscellaneous business expenses

APPENDIX 4.2

This Appendix contains the time-series constructed as described in this chapter. All series cover the period 1960-61 to 1972-73, i.e., they all have 52 elements. The observations are arranged in rows so that for any variable row 1 contains the observations for 1960-61 (I) to 1961-62 (IV), etc. The data are preceded by a list of the symbols used for all the variables tested in this study. They are:

PAi = price level, sector Ai
PBi = price level, sector Bi
PCi = price level, sector Ci
WAi = minimum wage rate index, sector Ai
WBi = minimum wage rate index, sector Bi
WCi = minimum wage rate index, sector Ci
EOAi = average weekly earnings (original), sector Ai
EOBi = average weekly earnings (original), sector Bi
EOCi = average weekly earnings (original), sector Ci
ESAi = average weekly earnings (seasonally adjusted), sector Ai
ESBi = average weekly earnings (seasonally adjusted), sector Bi
PYAi = productivity, sector Ai
PYBi = productivity, sector Bi
ULWAi = WAi/PYAi
ULWBi = WBi/PYBi
ULEOAi = EOAi/PYAi
ULEOBi = EOBi/PYBi
ULESAi = ESAi/PYAi
ULESBi = ESBi/PYBi
PYAi* = 4-quarter moving average of PYAi
PYBi* = 4-quarter moving average of PYBi
ULNWAi = WAi/PYAi*
ULNWBi = WBi/PYBi*
ULNEOAi = EOAi/PYAi*
ULNEOBi = EOBi/PYBi*
ULNESAi = ESAi/PYAi*
ULNESBi = ESBi/PYBi*
UPAi = unit prime costs, sector Ai
UPBi = unit prime costs, sector Bi
MAi = materials costs, sector Ai
MBi = materials costs, sector Bi
MCi = materials costs, sector Ci
TAi = sales tax rate, sector Ai
TBi = sales tax rate, sector Bi
TCi = sales tax rate, sector Ci
DEXAi = change in expenditure, sector Ai
DEXBi = change in expenditure, sector Bi
DEXCi = change in expenditure, sector Ci
DOPAi = change in output, sector Ai
DOPBi = change in output, sector Bi

OTAi	=	overtime hours, sector Ai
OTBi	=	overtime hours, sector Bi
OTCi	=	overtime hours, sector Ci
UAi	=	unemployed, sector Ai
UBi	=	unemployed, sector Bi
UCi	=	unemployed, sector Ci
VAi	=	vacancies, sector Ai
VBi	=	vacancies, sector Bi
VCi	=	vacancies, sector Ci

WA1	123.03708	123.86303	124.45480	124.92264	127.89150	128.14238	128.13498	128.20671
	128.11409	128.23488	128.45196	129.68339	130.63975	131.08121	131.43892	133.27430
	137.60277	137.93449	138.64161	139.22233	141.02528	141.56674	141.81193	142.30977
	148.92115	149.29566	151.50568	152.12241	155.94452	156.14817	159.36590	160.39540
	162.34753	169.06771	170.77930	171.61644	172.41285	175.30236	179.60859	180.32385
	181.76531	184.70312	199.56537	201.12690	206.49737	211.27549	214.29705	220.52884
	225.84062	230.04211	234.52758	246.81882				
WA6	123.75538	124.41025	125.02871	125.66512	128.61897	128.61897	128.77384	128.81025
	128.77384	129.01948	129.19230	130.83743	132.08358	132.18358	132.52922	134.34717
	138.71999	139.12922	139.81127	140.40255	142.37537	142.74819	142.99383	143.91280
	151.07690	151.38613	153.79485	154.24049	157.76767	157.93126	163.08307	164.81999
	167.73896	174.23024	175.80357	176.25844	176.60408	178.96767	183.04921	183.48562
	186.36099	188.43534	201.82560	203.22560	210.00510	215.81535	217.54253	223.26099
	228.71637	234.37124	238.04661	249.33687				
WB1	124.37279	125.50689	126.33984	126.77279	129.37279	129.50574	129.53869	129.53869
	129.40574	129.57279	129.83984	130.60574	132.23984	132.63984	133.03984	134.77279
	138.97164	139.33869	140.46705	140.93410	142.63525	143.43410	143.86705	144.60115
	150.96935	151.37049	153.06934	154.23754	157.97164	158.13869	158.93754	159.26934
	160.70459	168.01033	170.61377	172.20918	173.34328	176.37853	180.31148	181.48197
	183.31263	188.14443	203.68542	204.95476	208.86279	212.63329	216.73903	223.43788
	229.60608	233.40608	239.98231	252.14821				
WB2	123.85340	124.93027	125.60714	125.94558	128.79184	128.89184	128.89184	128.89184
	128.81236	128.97132	129.23027	130.07392	131.63027	131.94819	132.30715	134.08923
	138.31236	138.63027	139.24819	139.70714	141.54819	142.10454	142.44297	143.11984
	149.70193	150.11984	151.88402	152.95828	156.69671	156.85567	157.43254	158.00193
	159.66349	167.01202	169.44003	170.45533	172.14785	175.24524	179.10420	180.37846
	182.40941	186.94524	202.55012	203.86542	208.13708	212.70908	217.51429	224.62733
	230.39377	233.66021	239.97257	252.99604				
WB4	124.10654	125.26478	126.06478	126.46478	129.12743	129.20655	129.20655	129.20655
	129.10655	129.28566	129.52302	130.28566	131.94390	132.30214	132.61862	134.29774
	138.39774	138.81862	139.45598	140.03950	141.92302	142.68566	143.12742	143.94831
	150.32302	150.80214	152.42302	153.61862	157.35598	157.53510	158.13070	158.49774
	160.32742	168.08566	170.81862	171.95598	173.23950	176.43950	180.36038	181.56806
	182.91749	187.51309	203.75485	205.33837	209.45812	213.30756	217.61523	224.13171
	229.76354	233.08329	241.02618	253.58555				
WB5	123.30453	124.04558	124.64016	125.14272	128.25000	128.30785	128.24145	128.24145
	128.20776	128.34135	128.51463	129.91485	131.00493	131.21760	131.55726	133.40816
	137.64115	137.99272	138.59615	139.11958	140.97990	141.43844	141.65720	142.16123
	148.77608	149.14277	151.40045	152.09652	155.94353	156.14962	160.44727	161.31103
	163.16464	169.86006	171.60055	172.25121	172.83539	175.79858	180.11320	180.90653
	182.04835	184.44926	199.33424	200.99836	207.74415	212.21750	215.18170	221.17280
	226.33695	230.96153	234.79023	246.93012				

	124.27943	125.20933	125.92683	126.49259	129.24723	129.27708	129.42755	129.44360
	129.34979	129.59171	129.82202	130.98945	132.49383	132.77273	133.16940	134.95180
	139.43044	139.98633	140.74073	141.52597	143.55834	144.15340	144.49965	145.47974
WB6	152.22398	152.67892	154.72033	155.53046	159.34659	159.53368	161.80125	163.24986
	165.47164	172.35764	174.17805	175.02489	176.45333	179.42982	183.76178	184.74308
	187.54017	191.11691	205.05906	206.47464	211.98673	217.18862	220.10074	226.61463
	232.31416	236.82261	242.60103	254.41208				
	124.39479	125.61895	126.70861	127.59197	130.28620	130.42023	130.29134	130.19455
	130.06052	130.18989	130.69173	131.89696	132.88970	133.21208	133.53343	141.25046
WC1	139.21999	139.32895	139.57540	139.89819	141.54139	141.87866	142.14145	142.44939
	149.74188	149.91528	152.17312	153.11380	156.93758	157.37033	160.21256	161.68466
	164.98127	170.38621	172.11569	173.30944	174.01939	176.68181	181.43540	182.03498
	182.62819	184.77822	199.52965	201.64662	205.79880	209.58942	212.14105	219.33804
	225.20902	228.63654	232.13854	247.64799				
	123.75132	123.90010	123.98090	123.98090	127.95450	128.17123	128.66495	128.81043
	128.81043	128.85039	128.96469	130.13071	131.29911	131.57007	131.99719	133.86935
WC2	139.23322	139.37590	139.57531	140.02787	142.17673	142.33833	142.49743	142.95057
	150.67182	150.97553	153.66582	153.82722	157.35145	157.78889	160.56015	161.31703
	164.62653	171.11777	172.82633	173.55229	174.51250	177.23874	181.81857	182.64784
	184.87941	185.93305	200.43494	202.57326	207.94727	212.24804	215.90293	222.68224
	230.24649	232.82407	238.45672	252.68544				
	120.80314	122.57965	124.01663	124.83809	125.87499	125.87499	125.91608	125.91608
	125.88553	125.86663	125.86912	126.87763	128.96995	129.24935	129.32099	129.75087
	134.75428	135.46354	138.93617	142.39164	143.89083	145.32489	145.62301	148.21536
WC3	151.55578	152.22033	152.78692	154.78198	158.99804	159.35705	160.60367	161.18581
	163.58469	169.05892	170.89744	172.12246	173.57352	176.63274	180.74241	180.99796
	185.04751	189.40338	203.48002	205.06726	206.94436	214.95177	219.03142	223.69513
	228.35991	233.14042	240.07411	252.89598				
	120.78071	120.93097	120.96678	121.02786	125.40853	125.44191	125.45853	125.50881
	125.68844	125.89642	126.11957	127.36146	128.23364	128.38595	128.51351	131.02987
	136.04123	136.39193	136.71532	136.94470	138.50929	138.80134	139.11206	139.32047
WC4	146.75387	147.00281	149.38790	149.80718	153.90521	154.48291	158.06240	159.20987
	162.11750	168.13121	169.81155	170.05409	170.96643	173.07917	177.68499	177.94355
	178.84537	179.96409	192.59286	195.75010	201.50779	205.16851	207.06802	213.02006
	219.03062	224.08687	229.29345	243.27559				
	125.27242	126.17224	126.88554	127.52138	128.60923	128.04063	128.06491	128.06491
	128.10803	128.34311	128.65103	129.41171	131.33160	131.95592	132.17461	133.37325
	134.30253	136.32754	136.39494	138.02150	140.37371	141.41766	143.34155	145.82026
WC5	150.83249	152.87614	153.79672	154.98209	157.92862	158.63402	158.88772	159.38331
	161.73245	166.61258	167.98951	169.17171	171.71345	175.26215	177.41637	177.63044
	178.22294	191.92807	200.55948	202.45836	207.21468	215.42654	217.23840	219.54399
	224.82153	228.92472	233.06412	242.62701				

	123.40470	123.92640	124.34412	124.39727	128.05272	128.16691	128.19761	128.19761
	128.34564	128.58384	128.91653	129.83702	131.25391	131.50392	132.28034	134.80827
	139.69171	139.91494	140.21574	140.47011	141.82723	142.80079	143.34058	144.45758
WC6	151.91899	152.11739	153.76388	154.90444	159.18395	159.52335	162.79193	163.88059
	165.62910	171.06173	172.21328	172.75660	173.13177	176.46147	180.97988	181.15037
	182.42642	183.75010	198.37130	202.28186	204.04217	206.50900	209.76394	216.15162
	220.30475	221.38070	226.92721	243.78735				
	93.00372	95.45347	96.81866	92.01339	91.74603	100.51833	105.38415	99.49961
	96.35747	103.52015	105.14324	101.13739	104.03475	104.80283	105.86574	107.72266
	113.90391	111.20187	106.53045	115.25901	118.02530	115.11138	109.43618	115.27094
PYA1	116.59807	115.57811	115.13800	119.09658	126.33274	118.55952	117.13417	122.98047
	123.63715	123.24206	120.51011	123.79108	126.42708	123.84098	127.72077	137.16900
	133.32591	133.89311	135.99321	142.22182	144.00338	143.81545	135.81524	149.21304
	154.18321	154.13165	156.73320	161.46660				
	96.16966	94.66788	112.86835	109.98354	106.42584	102.67531	102.46840	101.05285
	92.60427	91.10054	96.19425	94.48781	89.76293	90.88057	95.45007	92.66024
	90.99833	93.19883	97.41525	100.70597	99.51414	96.63878	102.35137	100.52187
PYA3	98.82587	100.90313	100.38242	100.19386	100.77246	98.39214	98.74144	100.00309
	100.42187	96.97761	98.02521	100.99922	99.34956	100.10456	103.32308	110.01220
	112.05169	108.49783	111.62691	107.93121	113.85197	115.27050	109.91134	113.10357
	116.33054	110.45282	108.02753	102.42797				
	82.36124	85.36983	101.12160	97.32151	93.46615	102.19613	88.94522	86.33093
	96.13273	82.03146	99.75082	109.98393	94.69193	94.98699	99.17328	92.65817
PYA4	100.07975	93.50670	119.54963	93.29982	95.01604	95.79132	120.11330	123.02121
	128.17922	122.93864	121.80774	117.87745	126.21294	128.01899	119.79831	115.32197
	132.77565	134.88932	108.85261	128.28840	113.59458	120.83872	125.29747	134.53873
	156.03417	130.47887	122.45566	127.26639	135.35344	137.93689	142.86151	150.95712
	126.11118	165.69470	142.36131	129.60055				
	93.67511	98.09301	96.59015	88.81017	89.04801	95.69824	102.89502	99.16265
	101.89908	108.17564	111.46094	101.15990	109.42720	105.53527	109.27757	112.75052
PYA5	115.25530	108.42099	108.14410	111.07297	110.65619	105.33475	104.36874	112.16208
	108.21917	110.10625	110.76223	114.95887	114.73235	113.85195	113.47511	117.08127
	117.32301	117.80289	119.60861	118.29907	121.41356	120.61346	119.59863	121.53001
	118.47432	120.92910	116.25055	120.26607	123.06824	121.76342	113.71993	125.47442
	125.16386	129.78813	131.49104	129.76569				
	91.46388	94.58447	98.32335	92.29453	91.29041	94.97585	97.36086	94.98488
	96.66690	97.81667	103.37604	99.13308	100.37946	99.13877	102.47825	102.72780
	105.57574	101.67564	107.01039	104.75459	104.63837	101.15243	105.34535	109.26108
PYA6	107.50432	108.12007	106.87157	109.22060	111.19990	110.97030	108.99528	110.81570
	114.72303	114.85628	111.55434	114.85282	114.26153	115.38891	114.76181	119.67956
	121.35250	118.48803	114.30469	116.50882	120.58172	120.44825	115.75816	125.44564
	122.14902	130.00887	127.16222	122.88188				

	93.71520	91.02180	89.91275	89.69048	90.35527	91.07754	93.50453	92.43753
	94.89942	95.39408	94.54262	92.24763	93.89553	96.99301	94.29620	95.49347
	97.00446	98.05063	97.67464	99.26076	99.00870	98.14508	97.36510	97.22631
PYA7	98.36781	99.24880	101.82501	102.26902	102.30953	103.30629	104.51211	104.88693
	105.35093	106.95477	107.14904	105.16660	106.46375	107.32418	104.57382	107.70864
	107.34324	107.27983	107.69427	106.67694	107.51013	107.90493	106.80224	108.41727
	109.29363	112.33707	114.39847	113.55013				
	97.27683	98.05698	97.12626	101.10331	101.25893	108.54400	109.05439	104.34621
	100.78097	106.79231	107.50251	103.12141	106.08078	108.50176	108.46811	108.48188
	116.68762	111.51972	104.76347	113.16503	115.61654	116.54436	109.40650	112.00667
PYB1	114.67436	116.35759	115.00516	119.89934	133.11567	116.45359	115.78565	120.21043
	118.60896	117.57865	110.69430	111.20579	113.35204	109.98103	111.02591	127.39880
	115.30921	114.35668	112.94522	116.67714	117.65125	117.06802	107.64364	115.28727
	119.30810	119.44722	114.53801	122.12972				
	89.48713	92.87855	96.49276	82.88445	82.26065	93.78995	102.14703	95.85816
	94.23046	100.84320	103.68461	99.19575	102.03930	101.30155	102.42165	103.75313
	107.37493	104.14284	97.99579	108.80225	107.99447	104.72241	101.09542	107.14722
PYB2	109.04622	107.21922	107.22419	112.35316	115.36835	111.11432	107.31418	112.82074
	114.28665	115.45711	116.30264	119.15927	118.80027	117.04439	119.99047	126.24210
	123.15158	121.95901	125.31975	132.13843	131.43435	129.70363	123.95857	137.44216
	143.69700	137.78333	143.83581	147.03889				
	96.17150	94.66969	112.87050	109.98564	106.42788	102.67727	102.47035	101.05478
	92.60603	91.10228	96.19609	94.48961	89.76464	90.88230	95.45189	92.66201
	91.00007	93.20061	97.41711	100.70790	99.51604	96.64062	102.35333	100.52379
PYB3	98.82776	100.90506	100.38433	100.19578	100.77438	98.39401	98.74332	100.00499
	100.42379	96.97946	98.02708	101.00115	99.35145	100.10647	103.32505	110.01430
	112.05383	108.49990	111.62904	107.93326	113.85414	115.27270	109.91344	113.10572
	116.33276	110.45493	108.02960	102.42992				
	94.30378	98.08110	98.84006	89.74122	89.16484	97.69364	104.55809	98.31674
	94.12401	103.42736	104.39164	101.84030	104.93838	104.93551	107.13864	112.29951
PYB4	118.91927	120.26895	120.00390	127.20744	134.81179	126.15215	119.25784	129.40875
	127.89998	123.51626	123.67418	125.84925	129.91762	129.89372	129.18495	137.48053
	140.26418	138.84151	138.04421	146.10185	152.85546	150.89635	160.11896	161.98695
	169.80934	173.79920	179.70644	188.53327	193.85749	195.51600	188.53411	210.64843
	214.60835	219.04346	231.67547	231.23157				
	93.46045	95.35540	98.78669	94.13699	93.49796	100.75701	105.01751	99.68595
	95.87335	101.88182	103.98958	100.26137	102.09371	102.85790	104.42247	105.54790
	110.44910	108.46090	105.17857	113.11180	115.29838	112.40839	108.45948	113.19432
PYB 6	114.09036	113.48652	113.11776	116.38304	122.51695	115.53449	114.43598	119.52381
	120.03657	119.04319	116.98883	120.19054	122.01538	119.95548	123.93498	133.01541
	130.11862	130.05542	132.44047	137.14609	139.58608	139.63688	132.05608	143.84503
	148.47112	147.42176	148.97554	151.75920				

	132.29264	129.76274	128.54423	135.76572	139.39732	127.48160	121.58848	128.85147
	132.95709	123.87431	122.16854	128.22497	125.76543	125.07411	124.15624	123.71984
	120.80601	124.03972	130.14271	120.79084	119.48733	122.98241	129.58413	123.45676
ULWA1	127.72180	129.17296	131.58616	127.73030	123.43952	131.70445	136.05416	130.42347
	131.30966	137.18344	141.71367	138.63394	136.37336	141.55441	140.62599	131.46108
	136.33158	137.94819	146.74657	141.41775	143.39759	146.90737	157.78572	147.79461
	146.47549	149.25040	149.63491	152.86061				
	129.87464	133.09688	112.52047	116.10828	121.86890	126.32053	127.16116	129.04139
	140.70626	143.57764	136.28673	140.01806	149.83914	148.10647	141.64474	147.52822
	155.16768	152.14784	146.58896	142.89123	146.71281	151.59546	143.62289	148.22645
ULWA3	158.66291	155.89209	158.59351	159.59061	162.04824	166.07019	166.90054	167.29484
	170.58036	183.85687	184.34033	179.80337	183.39287	184.30729	182.14710	171.52643
	174.20531	183.87464	189.91836	197.71854	190.59837	194.67253	205.62027	205.21015
	205.19117	221.63309	233.36643	256.27766				
	151.64900	147.59312	125.59137	131.21456	138.76681	126.91284	146.49466	151.04667
	135.54176	159.45103	131.42749	120.29030	142.03956	141.70362	136.32704	147.53152
ULWA4	141.08748	151.64689	119.44831	154.23394	153.65826	152.93662	122.38445	121.11733
	122.32872	127.95001	130.69777	135.64936	129.38452	127.63731	137.56455	145.07210
	129.01461	132.18245	166.00429	141.55606	160.39498	152.68285	150.20256	140.25700
	125.10081	152.89831	173.12389	167.67978	160.32101	162.68308	158.19516	153.75227
	189.27744	147.74160	177.08463	202.54543				
	131.41164	125.90092	128.27395	140.18665	143.74269	133.75377	124.30145	128.98002
	125.51635	118.32608	114.92815	128.50942	119.44014	123.93960	119.87821	117.95954
ULWA5	119.12684	126.91269	127.69998	124.60277	126.78911	133.47921	134.81047	125.71094
	136.57469	134.41563	136.05721	131.35134	134.74840	135.96605	142.85071	139.56118
	141.23401	145.92171	144.63842	146.40859	142.81765	145.75488	150.58701	148.52298
	153.02894	150.58410	168.60136	164.13607	167.38681	173.20473	187.03845	173.90000
	178.16644	175.97911	174.91687	186.33585				
	135.30519	131.53348	127.16075	136.15662	140.88990	135.42281	132.26449	135.61132
	133.21400	131.89927	124.97316	131.98161	131.58427	133.33188	129.32424	130.77976
	131.39381	136.83633	130.65205	134.02997	136.06420	141.12186	135.73816	131.71460
ULWA6	140.53100	140.01668	143.90624	141.21923	141.87752	142.31849	149.62397	148.73344
	146.21211	151.69149	157.59456	153.46462	154.56129	155.09954	159.50360	153.31408
	153.56996	159.03323	176.56809	174.42936	174.15998	179.17682	187.92846	177.97429
	187.24373	180.27327	187.19917	202.90776				
	132.74261	137.54946	139.91341	140.92911	143.21246	142.07675	138.49596	140.09462
	136.35489	135.85749	137.29257	142.11747	141.00777	136.81398	141.04492	141.26621
	143.80783	142.88536	144.15205	142.55381	145.03776	146.92535	148.41048	149.44515
ULWA7	154.42044	153.45274	151.73090	151.75661	155.41075	154.10485	155.29301	156.26351
	157.56861	161.47013	162.48396	166.21247	165.87805	167.25029	175.95226	171.75966
	174.48700	177.47978	189.49062	192.26274	196.72564	200.73226	205.33277	208.36163
	211.72324	209.90400	210.57975	222.63294				

	127.85448	127.99384	130.07794	125.38936	127.76433	119.31174	118.78357	124.14317
	128.40295	121.33157	120.77842	126.65240	124.65956	122.24671	122.65341	124.23530
	119.09716	124.94534	134.08017	124.53856	123.36924	123.07253	131.49772	129.10048
ULWB1	131.65049	130.09078	133.09780	128.63919	118.67246	135.79547	137.26878	132.49212
	135.49110	142.89187	154.13059	154.85631	152.92472	160.37178	162.40488	142.45187
	158.97484	164.52421	180.34001	175.65974	177.52705	181.63225	201.34866	193.80967
	192.44802	195.40520	209.52199	206.45934				
	138.40360	134.50928	130.17261	151.95321	156.56555	137.42606	126.18266	134.46100
	136.69927	127.89292	124.63785	131.12852	128.99959	130.25289	129.17889	129.23873
	128.81252	133.11551	142.09609	128.40465	131.06986	135.69639	140.89953	133.57308
ULWB2	137.28301	140.01206	141.65089	136.14062	135.82297	141.16603	146.70246	140.04688
	139.70442	144.65287	145.68890	143.04831	144.90527	149.72545	149.26535	142.88297
	148.11780	153.28530	161.62665	154.28171	158.35821	163.99624	175.47338	163.43408
	160.33304	169.58524	166.83785	172.06063				
	129.87216	133.09434	112.51833	116.10607	121.86657	126.31812	127.15873	129.03892
	140.70358	143.57490	136.28413	140.01539	149.83628	148.10364	141.64204	147.52540
	155.16472	152.14493	146.58616	142.88850	146.71001	151.59257	143.62015	148.22362
ULWB3	158.65988	155.88911	158.59048	159.58756	162.04515	166.06702	166.89736	167.29164
	170.57711	183.85336	184.33681	179.79994	183.38937	184.30377	182.14363	171.52316
	174.20199	183.87113	189.91473	197.71476	190.59474	194.66882	205.61635	205.20623
	205.18727	221.62886	233.36198	256.27277				
	131.60294	127.71551	127.54423	140.92162	144.81877	132.25686	123.57393	131.41867
	137.16644	125.00141	124.07413	127.93135	125.73465	126.07948	123.78226	119.58890
	116.37957	115.42349	116.20954	110.08751	105.27493	113.10601	120.01511	111.23537
ULWB4	117.53171	122.09092	123.24563	122.06559	121.11982	121.28000	122.40644	115.28741
	114.30390	121.06298	123.74196	117.69596	113.33550	116.92761	112.64149	112.08808
	107.71933	107.89065	113.38205	108.91360	108.04748	109.09980	115.42486	106.40084
	107.06179	106.40961	104.03612	109.66736				
	132.97543	131.30806	127.47348	134.37077	138.23535	128.30579	123.24377	129.85141
	134.91735	127.19808	124.84138	130.64798	129.77668	129.08365	127.52945	127.85835
	126.23954	129.06617	133.81122	125.12044	124.51029	128.24079	133.22916	128.52212
ULWB6	133.42405	134.53485	136.77811	133.63671	130.06085	138.08316	141.39019	136.58354
	137.85103	144.78581	148.88434	145.62285	144.61565	149.58035	148.27273	138.88849
	144.13016	146.95036	154.83112	150.55087	151.86810	155.53815	166.67217	157.54082
	156.47094	160.64291	162.84622	167.64195				

	48.77224	50.01390	45.30119	50.36224	50.90139	48.94629	43.36516	49.04542
	49.71073	48.78277	44.60582	49.73432	47.86862	51.62074	46.37950	49.01476
	47.49617	51.70776	49.75103	49.10679	48.80310	51.77594	50.71449	50.92350
ULEOA1	52.23071	54.59511	51.50341	53.31807	50.81818	56.42735	53.86985	54.56151
	54.67612	58.66503	56.67574	58.64720	58.45267	63.54924	56.76446	57.66609
	60.52837	64.30503	60.15006	62.92986	62.49853	66.75222	65.67746	64.80667
	62.78245	67.53966	62.20762	66.63917				
	47.16664	50.42893	38.85943	42.13358	43.88032	47.91804	44.59912	48.29156
	51.72548	55.43326	48.75551	53.23438	55.47947	59.52868	51.44051	56.98237
ULEOA3	59.45164	61.69605	54.40627	56.20322	57.88122	61.67297	54.22497	58.39525
	61.62354	62.53522	59.07409	63.37713	63.70788	67.99324	63.90427	67.09793
	67.31601	74.55329	69.67595	71.88174	74.38383	78.61780	70.16825	71.90112
	72.02033	79.35643	73.27982	82.92319	79.05001	83.28237	81.15632	85.49686
	83.21117	94.24839	90.25477	105.04943				
	55.07445	55.92139	43.37352	47.61537	49.96461	48.14273	51.37994	56.52667
	49.82694	61.56175	47.01716	45.73395	52.59160	56.95517	49.50930	56.98365
	54.05689	61.49292	44.33305	60.66464	60.62134	62.21858	46.20637	47.71535
ULEOA4	47.51160	51.32642	48.68328	53.86951	50.86642	52.25787	52.67186	58.18493
	50.91295	53.59950	62.74540	56.59124	65.05592	65.12813	57.86230	58.79348
	51.71944	65.98769	66.79969	70.32493	66.49259	69.59704	62.43809	64.05792
	76.75767	62.82639	68.48771	83.02434				
	48.42268	48.66810	45.40836	52.17871	52.44362	51.41161	44.41420	49.21208
	47.00730	46.68334	42.07752	49.72326	45.50971	51.26248	44.93145	46.82905
	46.93927	53.03401	49.00868	50.95749	52.05312	56.58152	53.17684	52.33498
ULEOA5	56.27469	57.30828	53.53811	55.23715	55.95632	58.76052	55.60691	57.31062
	57.61870	61.37370	57.10291	61.36988	60.86635	65.24977	60.61943	65.08680
	68.11603	71.19874	70.36526	74.41833	73.13016	78.84141	78.43832	77.06750
	77.33862	80.20764	74.14954	82.91868				
	49.59335	50.47340	44.60792	50.20882	51.15543	51.80264	46.93878	51.37660
	49.55161	51.62719	45.36835	50.73988	49.61174	54.56997	47.91261	51.39796
ULEOA6	51.24283	56.55238	49.52790	54.03105	55.04673	58.92098	52.68387	53.72453
	56.64888	58.36104	55.48716	58.13921	57.73386	60.28640	57.89241	60.55099
	58.92453	62.94714	61.22577	63.21134	64.67619	68.20413	63.17433	66.09316
	66.50048	72.66557	71.56312	76.81822	74.63818	79.70228	77.05720	77.08518
	79.24747	80.07146	76.67372	87.56376				
	48.40197	52.44897	48.78062	51.66657	51.68487	54.01991	48.87464	52.79241
ULEOA7	50.47449	52.93830	49.60725	54.52714	53.03767	55.77721	52.06997	55.29174
	55.77063	58.64317	54.26178	57.02152	58.17670	60.72643	57.00195	60.37461
	61.91050	63.57760	58.23717	62.09114	62.75076	64.75889	60.37578	63.97365
	64.16650	67.59867	63.74299	69.03333	69.41330	73.32923	69.32902	73.43886
	75.17939	80.25740	76.01929	83.89817	83.71304	88.96720	83.51885	89.19243
	88.56875	92.66754	85.22842	94.75991				

ULEOB1	46.62981	48.68598	45.15771	45.83431	46.11939	45.32724	41.90570	46.76739
	47.52881	47.28805	43.62689	48.77746	46.94536	49.86094	45.26676	48.67172
	46.36310	51.56039	50.59015	50.01545	49.81986	51.13932	50.72825	52.40759
	53.10690	54.22938	51.56290	52.96109	48.22873	57.44778	54.49726	55.81878
	56.99401	61.49075	61.70146	65.28437	65.19512	71.55780	65.30008	62.08850
	69.98574	75.29074	72.42449	76.70740	76.49727	82.00360	82.86602	83.87743
	81.13447	87.15146	85.12458	88.10304				
ULEOB2	50.68886	51.40046	45.45419	55.90916	56.77076	52.45764	44.73943	50.90855
	50.83282	50.07774	45.23333	50.70782	48.80473	53.40491	47.93909	50.89003
	50.38420	55.21263	54.08396	52.02099	53.33607	56.91236	54.89863	54.78444
	55.84788	58.85139	55.30468	56.51822	55.64785	60.20826	58.79931	59.47488
	59.14952	62.62066	58.72610	60.92686	62.20524	67.23945	60.42147	62.65739
	65.52900	70.59749	65.27303	67.73200	68.47525	74.01489	71.95953	70.35687
	67.36397	75.55340	67.78562	73.17792				
ULEOB3	47.16574	50.42796	38.85869	42.13277	43.87948	47.91713	44.59827	48.29064
	51.72449	55.43220	48.75458	53.23336	55.47841	59.52754	51.43953	56.98128
	59.45051	61.69488	54.40523	56.20215	57.88011	61.67179	54.22393	58.39414
	61.62236	62.53403	59.07296	63.37592	63.70667	67.99194	63.90305	67.09665
	67.31473	74.55187	69.67462	71.88037	74.38241	78.61630	70.16691	71.89974
	72.01896	79.35491	73.27842	82.92161	79.04851	83.28078	81.15477	85.49523
	83.20958	94.24659	90.25305	105.04743				
ULEOB4	48.09988	48.67400	44.37472	51.63736	52.37490	50.36152	43.70776	49.63550
	50.89031	48.82654	44.92697	49.39106	47.45642	51.55548	45.82847	47.01713
	45.49305	47.80951	44.16523	44.49425	42.72623	47.24454	46.53782	45.36015
	47.61533	51.08639	47.94857	50.45719	49.41593	51.50365	48.84470	48.80691
	48.19477	52.07376	49.47690	49.69136	48.34633	52.15500	45.27883	48.83109
	47.52389	49.53993	45.51868	47.47173	46.42586	49.10084	47.31239	45.90587
	45.10542	47.52482	42.08473	46.53344				
ULEOB6	48.53390	50.06533	44.39870	49.22613	49.94762	48.83035	43.51655	48.95374
	49.96175	49.56723	45.10067	50.16887	48.77871	52.59684	47.02053	50.02468
	48.98184	53.01450	50.39049	50.03899	49.95734	53.02096	51.17118	51.85772
	53.37874	55.60132	52.42324	54.56122	52.40091	57.90478	55.14000	56.13944
	56.31617	60.73426	58.38164	60.40409	60.56614	65.60768	58.49841	59.46680
	62.02033	66.20255	61.76360	65.25888	64.47634	68.74974	67.54706	67.22513
	65.19786	70.61373	65.44699	70.90180				

	49.25609	48.01292	47.61479	49.75363	51.33737	47.05609	45.54765	48.54290
	50.22963	46.85078	46.88842	49.14107	48.44535	49.33073	48.45760	48.36494
	47.23279	49.63945	52.37939	48.93327	48.37946	49.86475	53.18168	50.66325
ULESA1	52.05918	52.86468	53.84842	53.06618	50.89734	54.74044	55.83341	54.31757
	54.83788	56.63651	59.41410	58.32407	58.29447	60.64229	60.20947	57.44738
	60.07835	61.24288	63.90025	62.08611	62.63742	63.76227	68.69627	63.80139
	63.62560	64.87960	65.39776	65.64825				
	47.63457	48.41135	40.84405	41.62441	44.25617	46.06755	46.84371	47.79677
	52.26541	53.23789	51.25046	52.59938	56.14790	56.88785	53.74538	56.22692
	59.12196	59.22821	57.28056	56.00462	57.37878	59.39645	56.86294	58.09681
ULESA3	61.42116	60.55313	61.76381	63.07772	63.80712	65.96056	66.23359	66.79794
	67.51517	71.97538	73.04243	71.48570	74.18252	75.02156	74.42674	71.62842
	71.48487	75.57755	77.84861	81.81137	79.22568	79.55201	84.88660	84.17064
	84.32867	90.53639	94.88322	103.48736				
	55.62082	53.68407	45.58868	47.03996	50.39257	46.28356	53.96580	55.94750
	50.34706	59.12366	49.42315	45.18842	53.22523	54.42851	51.72764	56.22818
	53.75713	59.03320	46.67518	60.45027	60.09511	59.92192	48.45425	47.47149
ULESA4	47.35557	49.69959	50.89988	53.61501	50.94565	50.69560	54.59176	57.92478
	51.06358	51.74613	65.77702	56.27945	64.87986	62.14895	61.37395	58.57049
	51.33491	62.84542	70.96446	69.38203	66.64035	66.47967	65.30800	63.06427
	77.78851	60.35196	71.99990	81.78977				
	48.90306	46.72096	47.72743	51.54815	52.89282	49.42620	46.64949	48.70786
	47.49798	44.83449	44.23074	49.13014	46.05802	48.98836	46.94467	46.20821
ULESA5	46.67898	50.91265	51.59782	50.77743	51.60127	54.49294	55.76382	52.06751
	56.08988	55.49186	55.97576	54.97619	56.04348	57.00385	57.63378	57.05438
	57.78917	59.25152	59.86191	61.03175	60.70162	62.26502	64.29840	64.83995
	67.60959	67.80833	74.75234	73.42054	73.29267	75.30997	82.04367	75.87204
	78.37725	77.04865	77.95208	81.68569				
	50.08535	48.45404	46.88612	49.60207	51.59359	49.80213	49.30113	50.85020
	50.06885	49.58255	47.68997	50.13463	50.20947	52.14913	50.05940	50.71655
	50.95868	54.29029	52.14447	53.84012	54.56889	56.74604	55.24686	53.44996
ULESA6	56.46285	56.51125	58.01356	57.86454	57.82379	58.48412	60.00260	60.28027
	59.09886	60.77054	64.18397	62.86306	64.50115	65.08424	67.00836	65.84249
	66.00606	69.20530	76.02488	75.78825	74.80404	76.13228	80.59907	75.88944
	80.31174	76.91783	80.60570	86.26170				
	48.88215	50.35057	51.27193	51.04220	52.12756	51.93377	51.33441	52.25151
	51.00136	50.84173	52.14579	53.87672	53.67667	53.30281	54.40304	54.55870
	55.46137	56.29744	57.12844	56.82003	57.67170	58.48485	59.77502	60.06605
ULESA7	61.70718	61.55246	60.88877	61.79779	62.84850	62.82289	62.57648	63.68763
	64.35634	65.26123	66.82281	68.65298	69.22544	69.97491	73.53657	73.16033
	74.62044	76.43562	80.75888	82.77328	83.89907	84.98222	87.35772	87.80889
	89.75821	89.01781	89.59910	93.35084				

	47.09241	46.73813	47.46399	45.28042	46.51442	43.57680	44.01474	46.28822
	48.02494	45.41525	45.85939	48.19562	47.51096	47.64900	47.29501	48.02645
	46.10600	49.49797	53.26284	49.83872	49.38740	49.25163	53.19611	52.13975
ULESB1	52.93250	52.51054	53.91062	52.71088	48.30386	55.73036	56.48368	55.56922
	57.16263	59.36452	64.68264	64.92468	65.01868	68.28451	69.26312	61.85302
	69.46540	71.70547	76.93995	75.67892	76.66727	78.33053	86.67488	82.57633
	82.22409	83.71898	89.48995	86.79296				
	51.19172	49.34401	47.77560	55.23352	57.25702	50.43184	46.99109	50.38695
	51.36343	48.09447	47.54804	50.10295	49.39274	51.03575	50.08707	50.21535
	50.10480	53.00412	56.94122	51.83717	52.87308	54.81157	57.56937	54.50445
ULESB2	55.66447	56.98605	57.82277	56.25120	55.73452	58.40831	60.94255	59.20897
	59.32451	60.45535	61.56352	60.59117	62.03690	64.16369	64.08842	62.41975
	65.04179	67.23570	69.34262	66.82386	68.62742	70.69964	75.26708	69.26550
	68.26865	72.57772	71.26181	72.08977				
	47.63366	48.41042	40.84327	41.62362	44.25532	46.06667	46.84282	47.79586
	52.26441	53.23687	51.24949	52.59837	56.14683	56.88676	53.74435	56.22585
	59.12084	59.22708	57.27947	56.00355	57.37768	59.39531	56.86186	58.09570
ULESB3	61.41999	60.55197	61.76263	63.07651	63.80590	65.95930	66.23232	66.79666
	67.51388	71.97400	73.04104	71.48434	74.18110	75.02012	74.42532	71.62705
	71.48350	75.57610	77.84712	81.80981	79.22417	79.55049	84.88498	84.16904
	84.32707	90.53467	94.88141	103.48538				
	48.57706	46.72664	46.64101	51.01335	52.82351	48.41666	45.90750	49.12694
	51.42153	46.89281	47.22600	48.80190	48.02818	49.26836	47.88189	46.39379
	45.24077	45.89713	46.49849	44.33703	42.35535	45.50061	48.80183	45.12832
ULESB4	47.45896	49.46717	50.13173	50.21881	49.49290	49.96393	50.62509	48.58870
	48.33736	50.27315	51.86744	49.41758	48.21548	49.76926	48.02679	48.64589
	47.17055	47.18089	48.35664	46.83523	46.52903	46.90153	49.48707	45.19378
	45.71118	45.65304	44.24292	45.84149				
	49.01539	48.06230	46.66621	48.63126	50.37543	46.94462	45.70666	48.45217
	50.48327	47.60418	47.40860	49.57044	49.36641	50.26352	49.12736	49.36148
	48.71022	50.89392	53.05263	49.86217	49.52368	51.06381	53.66059	51.59269
ULESB6	53.20344	53.83899	54.81014	54.30345	52.48253	56.17370	57.14986	55.88844
	56.48279	58.63418	61.20242	60.07129	60.40222	62.60656	62.04866	59.24126
	61.55922	63.05005	65.61439	64.38390	64.61962	65.67033	70.65180	66.18234
	66.07345	67.83259	68.80324	69.84750				

	128.88862	130.77101	132.16848	131.99597	132.74327	130.29055	128.30980	127.17027
	126.64501	126.54550	125.32051	125.15588	125.96642	125.09838	123.02551	122.41319
	125.37267	124.51209	123.52521	122.94312	123.60474	123.68363	124.08893	124.65408
ULNWA1	129.56989	128.56323	128.58943	127.39503	129.91993	129.29919	131.80130	132.38040
	132.88657	137.79651	138.68429	138.88758	138.43835	137.90983	138.53610	136.85132
	135.58883	136.08880	142.63456	138.98378	141.50440	143.93902	146.07469	149.97626
	149.61534	148.32455	150.51669	160.45299				
	127.67697	124.04932	121.30185	119.36671	121.57570	124.39308	128.47248	132.72434
	135.70266	138.53914	140.60866	142.48021	145.03693	145.64735	146.41344	147.33183
	151.31138	149.94581	147.76872	146.63847	147.20710	146.83037	147.49226	148.83070
ULNWA3	156.17335	157.12127	158.69812	159.50721	163.74621	164.22317	165.74266	168.63219
	173.13086	180.14423	182.58980	183.02531	181.70032	180.74723	179.57373	175.63087
	178.22008	180.88060	192.29461	191.69961	193.83004	199.66855	199.39564	205.30739
	212.72377	221.25814	232.74977	247.19551				
	157.81660	143.78638	136.66568	132.44312	133.71134	137.82660	140.01155	143.48986
	145.24781	139.12488	135.44438	134.68219	134.79993	137.99644	140.76735	141.61034
	142.77950	139.67691	141.43165	143.01154	144.58487	139.83511	130.51875	123.99617
ULNWA4	126.68788	127.53752	130.01490	130.17197	132.52584	133.22327	133.81783	134.02093
	137.78681	143.12663	145.96417	151.78394	151.90612	150.27030	146.04431	139.39058
	143.29235	147.82021	161.25658	164.38778	162.79222	161.65837	160.71968	162.38434
	163.11330	170.46315	180.61326	197.83139				
	129.42058	130.48072	132.21465	134.11251	137.16245	134.17015	130.11025	126.05021
	122.86411	121.42053	120.15899	121.24604	122.58919	121.34425	119.12204	119.75374
	123.38107	124.04219	125.38018	126.75879	129.51765	130.19875	130.49527	130.42121
ULNWA5	134.96792	133.74753	134.77017	133.50574	135.71969	135.17732	140.82641	141.06424
	141.61939	145.77525	145.88845	144.89329	144.52860	146.03755	149.56298	150.30550
	151.44933	152.85341	163.94985	164.18872	171.64521	175.24071	175.40460	178.08247
	177.33246	177.72763	175.97215	182.80444				
	134.47287	132.97554	132.80970	133.44673	136.68691	136.37351	135.09281	133.68993
	132.13503	130.68407	129.57130	130.40059	131.57373	131.23378	130.15711	130.70062
ULNWA6	133.80274	133.14279	133.62126	134.42082	136.66778	136.56030	135.59862	134.89665
	140.21546	140.26001	141.89190	141.23779	143.65043	143.19473	147.01274	147.34818
	148.88624	153.52373	154.30164	154.68900	154.35902	155.06448	156.58113	155.26274
	157.25671	159.61826	171.67698	172.64940	177.76517	180.69691	180.16318	182.79480
	183.32693	186.20844	188.83784	198.83324				
	136.27090	137.47855	138.85976	140.05734	142.66224	141.42849	140.14393	138.48416
	137.39282	137.45012	137.87975	139.14981	140.27838	140.03984	139.18867	140.41114
	144.36510	143.65731	143.31518	143.64571	145.81826	146.86561	147.67501	148.40538
ULNWA7	154.05289	152.62050	153.10293	152.28750	154.73511	153.93541	155.86473	156.14543
	156.97214	162.74796	163.79909	164.17192	166.29198	169.02867	172.57146	173.34067
	174.88533	177.36583	190.13206	191.07286	197.07417	201.60559	203.28614	207.90815
	210.06525	211.01143	213.32035	222.66752				

	126.55588	127.94748	127.75957	125.89467	125.00088	122.87947	122.50970	122.83352
	123.18930	123.75625	123.41017	123.11279	124.26075	123.71677	121.82159	121.51271
	125.39596	125.58834	126.09109	125.95210	126.11009	126.32914	127.00548	127.81292
ULNWB1	132.64742	131.05954	128.85845	127.35721	130.32351	130.31350	132.91454	135.08134
	136.87471	145.27797	149.83865	153.40551	155.67426	155.51434	155.86587	155.81196
	156.32673	161.96659	176.93890	177.06867	180.95306	185.56615	189.09562	194.08707
	197.45753	197.80596	200.34004	207.23731				
	133.59228	136.57127	140.29419	141.92451	143.80108	140.26372	135.65956	132.34777
	130.82544	130.18201	128.63374	128.15481	129.81610	129.60398	128.39900	128.85142
ULNWB2	133.16391	133.37048	133.05768	133.30517	134.47162	134.76970	135.18682	135.25798
	140.05069	138.60362	138.39091	137.76767	140.50525	140.55955	141.17295	141.16611
	140.55659	144.58664	144.98628	144.91113	145.53497	146.48632	147.94512	147.58658
	147.70143	149.67294	159.89747	158.42976	160.75155	163.66014	164.57628	166.74882
	166.70437	164.67701	166.56810	172.37879				
	127.66882	124.04017	121.29316	119.35834	121.56716	124.38413	128.46298	132.71589
	135.69559	138.52997	140.59924	142.47254	145.03107	145.64538	146.41146	147.32588
ULNWB3	151.30125	149.93193	147.75343	146.62353	147.19411	146.82117	147.48486	148.82327
	156.16557	157.11146	158.68823	159.50124	163.74210	164.22110	165.74266	168.63007
	173.12430	180.13285	182.57366	183.00686	181.68221	180.75166	179.60157	175.65948
	178.24856	180.89085	192.28589	191.69315	193.82788	199.66633	199.39124	205.30285
	212.71666	221.24814	232.73902	247.18387				
	127.32631	130.21287	133.26439	134.67132	136.53803	134.08732	131.77282	129.99954
	128.99529	128.63605	126.61407	125.46922	126.41786	124.78686	121.58201	119.12032
	119.03646	115.93701	112.84102	110.87188	111.79443	112.23382	113.10509	114.83596
ULNWB4	119.70896	119.98898	121.46471	121.40286	122.91395	121.02840	118.97577	117.12702
	116.56150	120.29103	119.96954	118.20921	115.69740	114.21419	113.73015	111.00497
	108.31291	107.36814	112.59118	109.98895	109.94744	109.74022	108.95266	109.19006
	107.56657	105.19742	105.91008	108.65837				
	129.73817	131.00465	131.93999	131.59520	132.45767	130.51864	129.37741	128.83165
	128.72386	129.03846	128.18446	128.19794	129.44697	128.81958	127.10036	126.69151
	129.92633	129.19231	128.05526	127.52242	128.33751	128.38742	128.85791	129.72179
ULNWB6	134.84275	134.08031	134.16173	133.35088	136.13258	135.64635	137.47796	138.55722
	139.54577	144.86117	145.98474	146.25016	146.24315	145.72536	146.13843	144.30798
	143.87845	144.86647	153.45717	150.42867	151.79043	154.64043	154.57055	158.22005
	160.14487	159.83303	163.68183	173.84998				

	47.51728	50.40251	46.57843	48.96385	48.47164	50.02478	45.76235	48.40549
	47.35073	49.83471	45.75666	48.54392	47.94512	51.63076	45.95711	48.49710
	49.29160	51.90468	47.22129	49.98179	50.48480	52.07116	48.56387	51.41737
ULNEOA1	52.98647	54.33741	50.33048	53.17812	53.48607	55.39684	52.18596	55.38017
	55.33273	58.92721	55.46420	58.75450	59.33777	61.91305	55.92086	60.03055
	60.19861	63.43827	58.46459	61.84676	61.67340	65.40345	60.80281	65.76330
	64.12826	67.12069	62.57420	69.94905				
	46.36852	47.00091	41.89212	43.31600	43.77475	47.18689	45.05904	49.66984
	49.88609	53.48797	50.30165	54.17048	53.70141	58.54028	53.17234	56.90652
	57.97412	60.80313	54.84413	57.67712	58.07622	59.73440	55.68585	58.63330
ULNEOA3	60.65661	63.02830	59.11305	63.34402	64.37542	67.23703	63.46093	67.63431
	68.32251	73.04783	69.01430	73.16981	73.69733	77.09923	69.17691	73.62163
	73.68013	78.06426	74.19669	80.39885	80.39034	85.41970	78.69952	85.53737
	86.26586	94.08894	90.01627	101.32662				
	57.31434	54.47906	47.19808	48.06119	48.14433	52.28272	49.10612	53.69866
	53.39501	53.71412	48.45417	51.20570	49.91105	55.46514	51.12187	54.69661
	54.70518	56.63909	52.49214	56.25054	57.04170	56.88855	49.27749	48.84950
ULNEOA4	49.20467	51.16095	48.42892	51.69431	52.10140	54.54490	51.23729	53.75257
	54.37471	58.03733	55.17074	60.68014	61.61286	64.09904	56.26043	58.43028
	59.24023	63.79609	62.22070	68.94427	67.51751	69.15866	63.43449	67.65431
	66.14733	72.48862	69.85241	81.09203				
	47.68901	50.43846	46.80335	49.91786	50.04286	51.57165	46.48974	48.09422
	46.01400	47.90419	43.99264	46.91289	46.70958	50.18902	44.64803	47.54133
ULNEOA5	48.61556	51.83449	48.11839	51.83922	53.17332	55.19093	51.47468	54.29592
	55.61263	57.02344	53.03166	56.14314	56.35967	58.41966	54.81892	57.92785
	57.77593	61.31210	57.59642	60.73471	61.59552	65.37631	60.20720	65.86795
	67.41291	72.27171	68.42397	74.44220	74.99063	79.76817	73.55943	78.92106
	76.97660	81.00458	74.59689	81.34722				
	49.28828	51.02676	46.58957	49.20953	49.62937	52.16631	47.94251	50.64868
	49.15026	51.15154	47.03758	50.13206	49.60777	53.71127	48.22117	51.36686
	52.18230	55.02590	50.65348	54.18861	55.29091	57.01644	52.62971	55.02244
ULNEOA6	56.52169	58.46247	54.71048	58.14686	58.45531	60.65758	56.88208	59.98704
	60.00222	63.70746	59.94646	63.71565	64.59155	68.18871	62.01683	66.93322
	68.09696	72.93288	69.58075	76.03432	76.18322	80.37845	73.87317	79.17307
	77.58975	82.70767	77.34489	85.80543				
	49.68849	52.42193	48.41327	51.34697	51.48629	53.77343	49.45620	52.18554
	50.85870	53.55888	49.81942	53.38853	52.76332	57.09235	51.38469	54.95706
	55.98675	58.96000	53.94677	57.45828	58.48978	60.70174	56.71947	59.95455
ULNEOA7	61.76314	63.23279	58.76378	62.30835	62.47795	64.68768	60.59806	63.92531
	63.92359	68.13363	64.25892	68.18582	69.58651	74.10895	67.99691	74.11485
	75.35102	80.20587	76.27662	83.37894	83.86135	89.35428	82.68638	88.99831
	87.87518	93.15645	86.33762	94.77462				

	46.15619	48.66835	44.35287	46.01902	45.12186	46.68264	43.22024	46.27402
	45.59896	48.23305	44.57751	47.41425	46.79517	50.46053	44.95977	47.60509
	48.81515	51.82573	47.57577	50.58314	50.92669	52.49251	48.99527	51.88492
ULNEOB1	53.50906	54.63322	49.92055	52.43330	52.96374	55.12865	52.76857	56.90962
	57.57602	62.51757	59.98331	64.67274	66.36731	69.39041	62.67086	67.91157
	68.81996	74.12031	71.05861	77.32265	77.97356	83.77969	77.82322	83.99748
	83.24644	88.22221	81.39414	88.43503				
	48.92676	52.18841	48.98848	52.21923	52.14236	53.54082	48.09957	50.10846
	48.64858	50.97406	46.68351	49.55787	49.11364	53.13885	47.64966	50.73752
	52.08622	55.31838	50.64380	54.00635	54.72034	56.52370	52.67279	55.47549
ULNEOB2	56.97379	58.25938	54.03189	57.19368	57.56621	59.94960	56.58305	59.95019
	59.51032	62.59198	58.44288	61.72026	62.47556	65.78480	59.88704	64.72002
	65.34479	68.93377	64.57470	69.55306	69.51015	73.86320	67.49076	71.78383
	70.04088	73.36669	67.67602	73.31323				
	46.36555	46.99744	41.88912	43.31297	43.77167	47.18350	45.05570	49.66668
	49.88349	53.48443	50.29828	54.16756	53.69924	58.53949	53.17162	56.90422
	57.97024	60.79750	54.83846	57.67124	58.07110	59.73066	55.68306	58.63038
ULNEOB3	60.65359	63.02437	59.10937	63.34164	64.37381	67.23618	63.46093	67.63346
	68.31992	73.04321	69.00820	73.16244	73.68998	77.10112	69.18764	73.63362
	73.69190	78.06868	74.19333	80.39614	80.38944	85.41875	78.69778	85.53548
	86.26298	94.08469	90.01212	101.32185				
	46.53680	49.62578	46.36486	49.34709	49.38010	51.05853	46.60768	49.09951
	47.85872	50.24626	45.84667	48.44049	47.71429	51.02690	45.01387	46.83290
	46.53163	48.02222	42.88503	44.81127	45.37219	46.88022	43.85835	46.82841
ULNEOB4	48.49740	50.20687	47.25570	50.18325	50.14792	51.39680	47.47574	49.58571
	49.14666	51.74172	47.96854	49.90806	49.35386	50.94469	45.71645	48.35924
	47.78576	49.30001	45.20117	47.94044	47.24223	49.38907	44.65945	47.10926
	45.31809	46.98342	42.84278	46.10531				
	47.35235	49.94965	45.95437	48.20932	47.86001	49.67251	45.68230	48.56930
	47.66821	50.28441	46.30841	49.22806	48.65479	52.48924	46.86232	49.56816
	50.41234	53.06631	48.22292	50.99961	51.49294	53.08158	49.49226	52.34178
ULNEOB6	53.94632	55.41346	51.42046	54.44452	54.84718	56.88292	53.61429	56.95068
	57.00853	60.76587	57.24463	60.66430	61.24774	63.91683	57.65637	61.78722
	61.91202	65.26373	61.21552	65.20591	64.44337	68.35294	62.64265	67.51497
	66.72871	70.25773	65.78281	73.52740				

ULNESA1	47.98869	48.38599	48.95727	48.37214	48.88681	48.09293	48.06549	47.90954
	47.84500	47.86106	48.09815	47.96487	48.52278	49.34030	48.01629	47.85414
	49.01827	49.82849	49.71600	49.80517	50.04656	50.14907	50.92643	51.15459
	52.81246	52.61515	52.62209	52.92689	53.56938	53.74074	54.08814	55.13257
	55.49644	56.88961	58.14402	58.43079	59.17718	59.08094	59.31468	59.80287
	59.75104	60.41740	62.10969	61.01753	61.81046	62.47392	63.59756	64.74319
	64.98948	64.47713	65.78314	68.90891				
ULNESA3	46.82852	45.12048	44.03162	42.79255	44.14970	45.36463	47.32678	49.16093
	50.40682	51.36964	52.87572	53.52431	54.34841	55.94330	55.55480	56.15207
	57.65264	58.37100	57.74156	57.47331	57.57209	57.52944	58.39489	58.33364
	60.45741	61.03058	61.80454	63.04475	64.47570	65.22695	65.77409	67.33192
	68.52465	70.52197	72.34881	72.76667	73.49788	73.57245	73.37524	73.34241
	73.13232	74.34691	78.82265	79.32088	80.56899	81.59361	82.31687	84.21053
	87.42439	90.38323	94.63249	99.81990				
ULNESA4	57.88293	52.29944	49.60857	47.48039	48.55670	50.26367	51.57755	53.14847
	53.95237	51.58683	50.93370	50.59490	50.51239	53.00458	53.41246	53.97146
	54.40182	54.37352	55.26531	56.05178	56.54655	54.78864	51.67477	48.59984
	49.04307	49.53937	50.63395	51.45009	52.18256	52.91426	53.10489	53.51224
	54.53558	56.03050	57.83639	60.34582	61.44611	61.16694	59.67485	58.20868
	58.79978	60.75818	66.09999	68.01987	67.66755	66.06093	66.35020	66.60486
	67.03567	69.63364	73.43459	79.88620				
ULNESA5	48.16212	48.42050	49.19367	49.31463	50.47150	49.58006	48.82949	47.60145
	46.49431	46.00700	46.24386	46.35329	47.27234	47.96252	46.64856	46.91105
	48.34597	49.76111	50.66049	51.65604	52.71175	53.15368	53.97885	54.01843
	55.42999	55.21604	55.44625	55.87790	56.44745	56.67318	56.81707	57.66886
	57.94686	59.19205	60.37927	60.40009	61.42882	62.38578	63.86115	65.61814
	66.91170	68.83020	72.69001	73.44410	75.15727	76.19522	76.94052	77.69684
	78.01038	77.81420	78.42237	80.13759				
ULNESA6	49.77725	48.98526	48.96897	48.61485	50.05446	50.15175	50.35537	50.12974
	49.66331	49.12574	49.44463	49.53406	50.20545	51.32851	50.38179	50.68586
	51.89294	52.82486	53.32951	53.99713	54.81096	54.91181	55.19007	54.74123
	56.33607	56.60946	57.20151	57.87215	58.54636	58.84420	58.95544	59.71884
	60.17974	61.50457	62.84285	63.36460	64.41674	65.06953	65.78061	66.67936
	67.59066	69.45989	73.91892	75.01487	76.35252	76.77817	77.26868	77.94494
	78.63176	79.45021	81.31130	84.52951				
ULNESA7	50.18143	50.32462	50.88581	50.72646	51.92729	51.69681	51.94524	51.65085
	51.38959	51.43774	52.36881	52.75168	53.39902	54.55960	53.68706	54.22847
	55.67629	56.60160	56.79678	57.25525	57.98205	58.46107	59.47879	59.64814
	61.56030	61.22858	61.43937	62.01398	62.57527	62.75382	62.80686	63.63950
	64.11272	65.77769	67.36367	67.81014	69.39818	70.71896	72.12361	73.83376
	74.79079	76.38655	81.03225	82.26101	84.04771	85.35195	86.48699	87.61778
	89.05532	89.48746	90.76519	93.36534				

	46.61409	46.72121	46.61804	45.46290	45.50835	44.87985	45.39544	45.79990
	46.07494	46.32283	46.85866	46.84867	47.35896	48.22199	46.97426	46.97397
	48.54446	49.75270	50.08920	50.40440	50.48462	50.55487	51.37882	51.61975
ULNESB1	53.33333	52.90158	52.19350	52.18558	53.04624	53.48056	54.69199	56.65518
	57.74636	60.35582	62.88148	64.31642	66.18770	66.21626	66.47433	67.65401
	68.30828	70.59077	75.48891	76.28592	78.14683	80.02706	81.40030	82.69452
	84.36442	84.74756	85.56820	87.12001				
	49.41215	50.10044	51.49040	51.58819	52.58897	51.47319	50.52033	49.59505
	49.15639	48.95529	49.07243	48.96672	49.70537	50.78149	49.78468	50.06486
	51.79739	53.10565	53.31932	53.81551	54.24534	54.43725	55.23525	55.19197
ULNESB2	56.78669	56.41280	56.49203	56.92348	57.65588	58.15738	58.64550	59.68216
	59.68638	60.42767	61.26662	61.38021	62.30648	62.77559	63.52157	64.47456
	64.85896	65.65121	68.60075	68.62050	69.66462	70.55474	70.59291	70.67033
	70.98151	70.47713	71.14659	72.22307				
	46.82553	45.11715	44.02846	42.78955	44.14659	45.36137	47.32328	49.15780
	50.40420	51.36624	52.87218	53.52143	54.34621	55.94254	55.55405	56.14980
	57.64878	58.36560	57.73559	57.46746	57.56701	57.52584	58.39196	58.33073
	60.45440	61.02677	61.80069	63.04239	64.47408	65.22613	65.77409	67.33107
ULNESB3	68.52205	70.51752	72.34241	72.75934	73.49055	73.57425	73.38662	73.35435
	73.14401	74.35113	78.81907	79.31821	80.56809	81.59270	82.31506	84.20866
	87.42147	90.37914	94.62812	99.81520				
	46.99847	47.64033	48.73279	48.75075	49.80306	49.08676	48.95337	48.59644
	48.35829	48.25631	48.19277	47.86267	48.28916	48.76323	47.03078	46.21201
	46.27360	46.10133	45.15065	44.65293	44.97834	45.14975	45.99200	46.58909
ULNESB4	48.33813	48.61553	49.40731	49.94616	50.22604	49.86027	49.20623	49.36401
	49.29206	49.95259	50.28620	49.63308	49.22029	48.61431	48.49096	48.17583
	47.43048	46.95239	48.01934	47.29766	47.34722	47.17685	46.71219	46.37851
	45.92670	45.13297	45.03985	45.41973				
	47.82212	47.95124	48.30133	47.62673	48.26994	47.75426	47.98141	48.07166
	48.16579	48.29294	48.67814	48.64085	49.24099	50.16069	48.96206	48.91100
	50.13279	50.94366	50.77054	50.81939	51.04595	51.12219	51.89999	52.07428
ULNESB6	53.76916	53.65709	53.76169	54.18730	54.93261	55.18238	55.56853	56.69605
	57.17719	58.66470	60.01047	60.33006	61.08199	60.99306	61.15551	61.55288
	61.45171	62.15594	65.03213	64.33164	64.58658	65.29130	65.52196	66.46768
	67.62486	67.49061	69.15629	72.43405				

	123.14800	123.85291	124.44013	124.81897	127.48410	127.57792	127.53858	127.58363
	127.46194	127.59013	127.84791	128.99116	130.21185	130.52412	131.04360	132.77789
	137.07535	137.59715	138.34081	139.39536	141.17442	141.78579	142.04902	142.67528
UPA1	148.70524	149.22503	151.22498	152.02774	156.03648	156.17657	157.58014	158.64048
	160.13648	166.31361	168.12569	169.13556	170.24167	173.66360	178.38384	179.29001
	180.79544	184.13394	198.01032	199.67706	204.74038	209.07110	212.35012	218.53831
	223.22344	226.86647	231.41582	242.78833				
	131.15917	132.22865	133.21049	133.63419	136.37440	136.47218	136.38401	136.40177
	136.43239	136.54431	136.71130	137.95164	139.37178	139.76624	140.56322	142.34091
	146.83737	147.49732	148.34853	150.50660	152.48225	153.03973	153.41384	154.22067
	160.58920	161.73002	164.17815	165.22349	171.34644	171.53605	172.63498	173.84292
UPA2	174.71297	180.93418	182.88082	184.05397	184.89532	190.71963	197.91755	198.93413
	200.02397	202.80846	218.14172	220.39195	227.78554	232.66126	236.24714	242.45474
	247.32829	252.90072	255.56235	266.66519				
	121.88830	122.50069	123.08103	123.56404	125.87142	125.90812	126.08026	126.14070
	125.96910	126.21736	126.52789	127.71439	129.14877	129.40786	129.94758	131.57164
	135.78970	136.37172	137.14573	138.12026	139.85480	140.33833	140.62265	141.69594
	148.01308	148.49828	150.30429	150.96244	154.37989	154.47722	156.05936	157.73355
UPA3	160.31257	166.43929	168.33392	169.18839	169.91566	172.45813	176.31138	176.97363
	179.97487	183.29339	195.62895	197.11432	201.79452	207.04102	209.19742	214.83513
	219.70205	224.00176	229.51070	239.78045				
	121.88830	122.50069	123.08103	123.56404	125.87142	125.90812	126.08026	126.14070
	125.96910	126.21736	126.52789	127.71439	129.14877	129.40786	129.94758	131.57164
	135.78970	136.37172	137.14573	138.12026	139.85480	140.33833	140.62265	141.69594
UPA4	148.01308	148.49828	150.30429	150.96244	154.37989	154.47722	156.05936	157.73355
	160.31257	166.43929	168.33392	169.18839	169.91566	172.45813	176.31138	176.97363
	179.97487	183.29339	195.62895	197.11432	201.79452	207.04102	209.19742	214.83513
	219.70205	224.00176	229.51070	239.78045				
	120.54095	120.85886	121.21164	121.54523	124.01203	124.07297	124.00421	124.03815
	123.83029	123.93683	124.26579	125.44613	126.44974	126.82127	127.34873	129.04283
	133.11463	133.67961	134.29930	135.24582	136.74831	137.13419	137.26816	137.81402
UPA5	143.31421	143.82663	145.57843	146.19714	149.76883	149.87343	151.72304	152.97194
	154.67298	160.18919	161.79725	162.64150	163.23348	166.04068	170.16090	170.98115
	172.01781	174.52620	186.64005	188.20605	193.76978	197.90726	200.37653	205.75004
	209.74803	213.37121	217.04738	226.93309				
	121.79904	122.29254	122.78004	123.20722	125.61912	125.66201	125.77169	125.82440
	125.66454	125.86988	126.17450	127.44583	128.77843	129.05161	129.55874	131.22485
UPA6	135.55016	136.18559	136.89331	137.92425	139.68671	140.24483	140.49747	141.40385
	147.52677	147.98724	149.86378	150.50661	153.98435	154.07614	156.08443	157.60945
	159.94556	165.90330	167.74244	168.55379	169.35513	172.02510	176.30757	177.15610
	179.62787	182.69610	195.19618	196.74259	201.60597	206.55576	208.95678	214.76226
	219.59655	223.64504	228.50605	238.70057				

	121.87922	122.62055	123.21807	123.62987	126.14076	126.26411	126.24797	126.29738
	126.06230	126.20793	126.48553	127.52561	128.74491	129.11459	129.59370	131.27707
	135.44078	135.90745	136.99946	137.77997	139.37782	140.10740	140.41500	141.01176
UPB1	146.80702	147.16847	148.99035	149.80069	153.38603	153.54585	154.73040	155.63568
	157.08869	163.10639	164.94357	166.34442	167.26049	170.22365	174.32537	175.05628
	176.71173	180.49634	193.71938	195.05309	199.21178	202.93470	205.85319	211.92466
	216.70677	220.27879	224.92433	236.03250				
	119.66804	120.31420	120.72048	120.93592	123.95030	123.96343	123.93068	123.95236
	123.87219	123.91046	124.13115	125.35647	126.40634	126.58360	126.93046	128.80341
	133.12216	133.41312	133.93761	134.52698	136.29484	136.57767	136.76945	137.18430
UPB2	143.34409	143.54990	145.66020	146.11333	149.49990	149.54822	150.15293	151.67359
	153.43932	159.07093	160.24823	160.93307	163.18511	165.94287	169.79056	170.36595
	172.93783	176.45298	189.22197	190.26816	194.11977	199.31034	203.56669	211.00832
	214.89109	217.04960	220.14273	233.55348				
	124.35821	125.07099	125.72397	126.08975	128.94388	129.05979	129.01873	129.08495
	129.05677	129.17726	129.37955	130.70146	131.91441	132.13328	132.73860	134.50166
UPB3	139.12326	139.73786	140.41098	141.83723	143.85379	144.55090	144.81118	145.45701
	151.76991	152.34754	154.63267	155.38557	159.87488	160.03137	161.90680	163.14496
	164.46874	170.71782	172.35102	173.24069	174.33337	178.36345	184.05453	184.99476
	186.47942	189.51345	204.41684	206.72139	211.81711	216.37662	219.70356	226.21516
	230.83896	234.49214	238.85224	250.96094				
	121.26837	121.71191	122.16501	122.45635	124.98072	125.05501	124.99302	125.03787
	124.86697	124.95847	125.26215	126.38050	127.45851	127.82175	128.35883	130.06846
UPB4	134.23411	134.78391	135.37621	136.48698	138.08350	138.45575	138.62795	139.20486
	144.80929	145.38380	147.20590	147.83576	151.71361	151.81668	152.89296	154.28233
	155.87471	161.41698	162.98626	163.88707	164.74427	167.96442	172.47449	173.26523
	174.52056	177.26492	189.65811	191.24414	196.42121	200.81787	203.64830	209.40201
	213.38587	216.87969	220.38465	230.74063				
	123.27058	123.91057	124.45826	124.91542	127.61551	127.72951	127.68693	127.75956
	127.66387	127.81023	128.05656	129.30999	130.46225	130.71503	131.23953	132.97953
	137.37669	137.95146	138.62919	139.83484	141.77065	142.53916	142.79299	143.42017
UPB5	149.49070	150.03453	152.22401	153.02370	157.04352	157.17767	158.95155	159.98437
	161.50450	167.66318	169.40561	170.25950	171.60621	175.04767	180.02593	180.94579
	182.45515	185.79767	199.74586	201.47068	206.88810	211.30213	214.41192	220.44980
	225.15446	228.73095	233.87458	245.15608				

	93.51430	92.53910	93.52110	95.22850	93.61330	91.95410	92.95100	93.31960
	93.16490	94.46100	97.22220	98.82190	102.04430	106.62500	107.30320	105.01550
	103.02860	101.97400	99.46870	98.69300	100.17510	101.15390	102.07080	103.79190
MA1	102.09860	99.58960	100.23440	99.98930	98.32910	96.94880	93.53690	92.87560
	95.30170	95.18720	94.86670	96.40380	99.47360	96.83960	97.28750	98.53040
	97.71410	97.63070	100.41020	105.90370	107.94700	109.79610	117.21450	122.02170
	121.94140	133.41190	147.77580	149.49060				
	92.43722	91.22867	90.36947	90.18493	90.02013	89.85533	89.85533	89.85533
	89.25105	89.30599	89.80039	90.23986	91.90731	93.30304	94.77904	95.64943
	97.90437	98.81983	99.12970	99.73397	99.78464	99.47477	99.00010	99.30997
MA6(1)	99.52432	100.12005	99.92048	99.94115	100.48151	100.66784	99.43457	100.51864
	101.09894	101.69987	103.09984	104.74516	104.53661	104.89714	105.64192	106.43180
	106.13761	106.33897	108.37575	109.65691	111.42544	111.93710	112.54316	114.31830
	113.24653	113.83870	114.15215	116.63018				
	92.98656	92.82176	92.34709	91.88788	91.77801	91.77801	91.50334	91.33854
	91.06387	91.06387	91.06387	90.95400	92.18198	93.08331	93.73529	94.66062
	96.09155	96.23794	97.70142	98.08596	97.86195	97.33235	97.24221	97.22248
MA6(2)	97.65657	98.69177	99.09647	98.73260	98.77856	99.51423	100.14871	100.40877
	101.09894	101.53507	103.53931	104.52542	105.41555	106.49023	108.77315	109.28836
	109.04911	109.14060	110.57310	112.89801	115.87509	116.66141	118.47602	121.13010
	122.03595	123.01266	124.91919	128.38604				
	94.99311	93.82282	93.91386	94.19350	92.37212	91.96379	92.56738	92.40016
	93.57045	94.27672	94.70566	96.36148	100.80155	103.50385	103.10487	103.67466
	101.73612	101.66417	100.32922	99.59375	100.68389	99.99695	99.85828	101.24342
MB1	100.15226	99.35137	100.45738	100.48030	100.35111	98.96519	93.60963	92.54983
	95.90296	94.42166	94.51577	96.64061	101.56915	99.11615	100.46352	102.69412
	103.37607	105.66928	109.67695	116.74456	119.36082	122.00884	128.93905	130.64135
	125.55851	126.32662	126.13481	134.91393				
	88.24018	87.96073	92.12009	98.91918	98.03927	91.91918	94.31873	96.59818
	91.71827	95.11782	106.19636	107.59590	106.47581	117.75527	122.27490	109.79681
MB2	107.63745	103.07854	96.39954	95.48036	98.36027	105.27945	109.96073	112.87991
	109.03927	100.43882	99.43882	98.23791	91.11782	89.75754	93.27718	94.03700
	93.15709	97.91691	96.11782	95.55891	92.00000	88.72055	85.96073	83.68127
	77.52191	68.96300	67.36255	67.24246	67.24246	66.24246	75.40182	91.28173
	109.04155	158.67900	224.95163	201.47354				
	92.43228	91.59565	92.40970	93.90290	92.51721	91.09378	91.94903	92.26526
	92.13254	93.24447	95.61332	96.98571	100.27596	104.48995	105.39859	103.60647
	102.21451	101.49448	99.37359	98.70811	100.06486	100.87617	101.63437	103.13933
MB6	101.64401	99.66203	100.24363	100.09019	98.77956	97.76589	94.89563	94.38513
	96.56596	96.63824	96.57641	98.15086	100.92655	98.78050	99.27842	100.45839
	99.81492	99.91388	102.78154	107.80706	109.68792	111.53006	118.09329	122.47318
	122.61742	132.77066	145.51984	147.67301				

	100.00000	102.42757	102.42757	100.00000	95.38472	95.38472	95.38472	93.56222
	93.56222	93.56222	93.56222	93.56222	93.56222	93.56222	93.56222	93.56222
	97.64902	97.64902	97.64902	97.64902	109.13724	109.13724	109.13724	109.13724
TA1	109.13724	109.13724	109.13724	109.13724	109.13724	109.13724	109.13724	109.13724
	112.81724	112.81724	112.81724	112.81724	112.81724	112.81724	112.81724	112.81724
	117.77393	117.77393	117.77393	117.77393	125.02627	125.02627	125.02627	125.02627
	125.02627	125.02627	125.02627	125.02627				
	100.00000	100.00000	100.00000	100.00000	51.90524	51.90524	51.90524	51.90524
	51.90524	51.90524	51.90524	51.90524	51.90524	51.90524	51.90524	51.90524
	51.90524	51.90524	51.90524	51.90524	51.90524	51.90524	51.90524	51.90524
TB4	51.90524	51.90524	51.90524	51.90524	51.90524	51.90524	51.90524	51.90524
	51.90524	51.90524	51.90524	51.90524	51.90524	51.90524	51.90524	51.90524
	55.03456	55.03456	55.03456	55.03456	55.03456	55.03456	55.03456	55.03456
	55.03456	55.03456	55.03456	55.03456				
	100.00000	102.70120	102.70120	100.00000	100.28566	100.28566	100.28566	98.25773
	98.25773	98.25773	98.25773	98.25773	98.25773	98.25773	98.25773	98.25773
	102.80519	102.80519	102.80519	102.80519	115.58835	115.58835	115.58835	115.58835
TB5	115.58835	115.58835	115.58835	115.58835	115.58835	115.58835	115.58835	115.58835
	119.68315	119.68315	119.68315	119.68315	119.68315	119.68315	119.68315	119.68315
	124.84582	124.84582	124.84582	124.84582	132.91563	132.91563	132.91563	132.91563
	132.91563	132.91563	132.91563	132.91563				
	100.00000	102.42757	102.42757	100.00000	95.38472	95.38472	95.38472	93.56222
	93.56222	93.56222	93.56222	93.56222	93.56222	93.56222	93.56222	93.56222
	97.64902	97.64902	97.64902	97.64902	109.13724	109.13724	109.13724	109.13724
TB6	109.13724	109.13724	109.13724	109.13724	109.13724	109.13724	109.13724	109.13724
	112.81724	112.81724	112.81724	112.81724	112.81724	112.81724	112.81724	112.81724
	117.77393	117.77393	117.77393	117.77393	125.02627	125.02627	125.02627	125.02627
	125.02627	125.02627	125.02627	125.02627				

OTA1	1.82394	1.80426	1.49203	1.19380	1.35760	1.67508	1.90713	1.75471
	1.82498	1.94412	1.92421	1.86763	1.92965	2.03380	2.19810	2.38139
	2.29444	2.30070	2.47198	2.55264	2.34729	2.12348	2.08402	2.15429
	2.08665	2.16938	2.06543	2.15057	2.13847	2.21529	2.15387	2.03888
	2.24262	2.16511	2.20664	2.26350	2.39859	2.34447	2.44484	2.37766
	2.34677	2.25479	2.20664	2.32306	2.29496	2.21102	2.02120	2.49307
	2.29496	2.21102	2.31217	2.49183				
OTA5	3.45793	3.06510	2.29308	1.77467	1.51720	1.96305	2.03391	2.36330
	2.73040	2.80138	2.83007	2.65033	2.89437	3.14657	3.42919	3.63635
	3.74394	3.52994	3.98709	3.80915	3.35427	3.03272	2.93081	3.13314
	3.07378	3.21032	3.40436	3.29831	3.26405	3.52568	3.80277	3.55920
	3.56803	3.46038	3.55831	3.70525	4.22082	3.93632	3.86329	3.88125
	3.88566	3.93759	3.94539	3.87841	3.87855	3.34060	2.75165	3.14499
	3.00740	3.24172	3.48274	3.87889				
OTA6	3.41277	2.98342	2.28821	1.77166	1.54614	1.97168	2.03573	2.35119
	2.66058	2.74082	2.78425	2.61553	2.85516	3.11181	3.41054	3.59422
	3.72704	3.52767	3.96280	3.79650	3.39812	3.10315	2.98624	3.20384
	3.13951	3.25885	3.41403	3.32325	3.28091	3.52394	3.78857	3.57736
	3.57283	3.48947	3.58689	3.74349	4.23407	3.97510	3.93004	3.93588
	3.94023	3.97621	3.95150	3.90800	3.92130	3.40725	2.85443	3.26500
	3.15756	3.37753	3.64694	4.00998				
OTB6	2.08953	1.92960	1.65155	1.31035	1.44017	1.75003	1.93675	1.86162
	1.89601	2.02078	2.03611	1.97245	2.06511	2.20784	2.42429	2.57269
	2.56938	2.55435	2.74809	2.79434	2.63275	2.43362	2.35557	2.47946
	2.40513	2.46990	2.36235	2.43339	2.40291	2.48683	2.47519	2.38825
	2.52842	2.48590	2.53836	2.63052	2.80286	2.74384	2.85542	2.78547
	2.76189	2.67295	2.58128	2.69916	2.69934	2.56090	2.34886	2.83355
	2.69934	2.65771	2.83641	3.00515				

CHAPTER 5

TYPE A RESULTS

5.1 Introduction

In this chapter we will discuss the results of estimating price equations for sectors of type A using the data described in the previous chapter. Before presenting the regression results some preliminaries will be discussed in this introductory section. These relate to the limits placed on the experimentation by the impossibility of testing all possible combinations of variables and lag structures, the estimation method used, the statistical problems encountered and the test statistics used. The following section (5.2) will describe the results for type A sectors in general, concentrating on results which appear to be common to most sectors. Section 5.3 will be concerned with a description of the results for each sector in turn and the final section will attempt to compare the results obtained for the different sectors one with another and with the aggregate equation (i.e. the equation for A7).

Consider first the limits placed on the experimentation. Obviously, given the number of sectors and the number of explanatory variables (including lagged variables) which were relevant for each sector an almost infinite number of plausible relationships could have been estimated. For this reason several limitations were placed on the equations to be estimated. The most severe limitations were placed on the experimentation with different lag structures. It will be recalled that in Chapter 3 it was felt that one and two period lags on the cost variables would be most likely to be useful. In addition it was felt that, since Almon lags had been reasonably successful in the T-ABS study, these types of lags ought also to be tried in this study. In the event experimentation with lags on cost variables was restricted mainly to one period lags since these appeared to be the more important. Almon lags were not experimented with. In most cases little experimentation with lags on demand variables was carried out. As regards the variables tested, all variables for which data were available were tested, at least in current form, with the exception that the variable (ULC-ULCN) was not tested as it appears to have been of only marginal significance in the studies reviewed. Added to this was the fact that neither ULC nor ULCN performed very satisfactorily in the estimated equations, this probably being due to the rather questionable quality of the short-run productivity data used. If this is in fact the case then the testing of (ULC-ULCN) would appear to be of limited usefulness. If these limits on the experimentation are compared with the programme set out in Chapter 3 (and modified in Chapter 4) it will be seen that a considerable amount of experimentation was still undertaken. In fact, 9 different labour cost variables, UPA, MA, TA, two different produce market demand variables and four different labour market demand variables were tested, in most cases for each of the 7 sectors. In addition, one-period lags were tried for the most successful labour cost variables, UPA and MA.

Turn now to a consideration of some statistical questions. Firstly, all equations were estimated by the single equation least squares (SELS) method. Since the price equations proposed in this study ought to be part of a system of simultaneous equations, the estimates of the parameters obtained using SELS will be biased and inconsistent.[1] However, in this study the relative simplicity of the SELS method outweighed any distinct advantage associated with more complex methods.

Secondly, consider the test-statistics used. The statistics accompanying each equation presented in this and the following chapters are $\bar{R}^2$, the t-ratio for each estimated coefficient and the Durbin-Watson statistic (DWS). Since no equations were estimated with the lagged dependent variable on the right-hand-side, the DWS may appropriately be used to test the null hypothesis that the first order serial correlation in the residuals is zero against the alternative hypothesis that it is non-zero for each equation. In general an attempt has been made to obtain an equation for each sector having a satisfactory $\bar{R}^2$, all the coefficients significant at the 5% level and a satisfactory DWS at the 1% significance level. Besides this, it was required, of course, that the coefficients be of the correct sign. In section 5.4, where the preferred equations for different sectors are compared, the partial correlations coefficient corresponding to each variable in the preferred equations is used to measure the relative importance of the variable in the regression equation.[2]

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1. See, e.g., J. Johnston, *Econometric Methods* (New York: McGraw-Hill, 1963), Ch. 9, and J. Kmenta, *Elements of Econometrics*, (New York: Macmillan, 1971), Ch. 13.

2. For an explanation of this and other statistics as measures of the contribution of individual variables to the calculated value of the dependent variable see A.S.Goldberger, *Econometric Theory*, (New York: Wiley & Sons, 1964), pp. 197-200.

It should be noted that the partial correlation coefficient is closely related to the t-ratio[1] and in most cases the relative sizes of the t-ratios will give an unambiguous indication of the relative sizes of the partial correlation coefficients. This will not necessarily be the case if the partial correlation coefficients from different equations are compared and hence in the final section the partial correlation coefficients will be included in the table containing the preferred estimated equation for each sector.

In general it was not possible, even given the limitations placed on the extent of experimentation, to estimate all plausible equations for type A sectors at the same time. Hence the approach generally taken was to experiment with various cost variables (labour cost variables, materials cost variables, and sales tax variables) first. These equations with only cost variables usually had unsatisfactory DWS's but this was to be expected since they were incomplete. On the basis of these equations, the "best" types of variables were chosen (i.e. those with the highest $\bar{R}^2$ and t-ratios) and further experimentation was carried out with these equations by trying various additional explanatory variables and lag structures. It is recognized that this is not an ideal method but given the number of equations and variables to be estimated, it appeared to be the only possible approach.

Finally in this introductory section it should be noted in advance that, as expected[2], the problem of multicollinearity was

1. See, e.g., H. Theil, *Principles of Econometrics*, (Amsterdam: North-Holland, 1971), p. 174.

2. See above p.71.

encountered in many of the equations, especially where both the current and lagged form of the same variable were used in the same equation. The presence of multicollinearity made the parameter estimates in some equations somewhat unreliable. Since the partial correlation coefficients are closely related to the t-ratios, the presence of multicollinearity will also affect these measures making them somewhat unreliable. However, the alternative measure, the β coefficient, is also made unreliable by the presence of multicollinearity since it is dependent on the estimated regression coefficient. Hence, it was decided to proceed with the use of the partial correlation coefficient, keeping in mind its limitations when the preferred estimated equations are compared.

5.2 General Observations on the Results

In this section each type of variable will be considered in turn and an attempt made to state some results which were common to most sectors. This will be done to avoid repetition in the next section as far as possible.

Firstly, consider the various labour cost variables tested. The discussion here will relate mainly to estimated equations of the form:

$$(5.1) \qquad PAi = \hat{a} + \hat{b}Xi$$

where PAi = price level in sector i,

Xi = labour cost variable for sector i.

On the whole, a comparison of the various forms taken by Xi was made on the basis of the $\bar{R}^2$ associated with the equations and the t-ratio associated with the coefficient of Xi. The forms taken by Xi are as follows: WAi[1], EOAi, ESAi, ULWAi, ULEOAi, ULESAi, ULNWAi, ULNEOAi, ULNESAi. In addition, short-run productivity (PYAi) was tried as a separate variable in equations with WAi, EOAi, ESAi.

Estimated equations of the form (5.1) with Xi as WAi, EOAi or ESAi showed a strong correlation between the dependent and the independent variables. The labour cost variable was always highly significant and the $\bar{R}^2$ was generally greater than 0.9. On the basis of both $\bar{R}^2$ and the t-ratio (both of these usually led to the same conclusion) WAi and ESAi were better than EOAi. This was so for all sectors. This bears out the point made previously that firms are less likely to adjust their prices to increases in earnings which are known to be temporary and of a seasonal nature than they are to increases in earnings which result from, for example, a wage rise which is likely to be permanent. Thus little further experimentation was carried out using EOAi. When the $\bar{R}^2$'s and t-ratios of equations with WA and ESA are compared there is little basis for choosing between them, ESA having higher associated $\bar{R}^2$'s and t-ratios for some sectors and WA for others.

When short-run productivity (PYAi) was added to (5.1) as a separate variable it was seldom significant and of the right sign. The only exception is sector A5 where PYAi was significant and of the right sign in the equations with WA, EOA and ESA. Hence, except for sector A5, little further experimentation was carried out with short-run productivity. More will be said about this variable when we

1. A list of the symbols used to denote the variables tested is contained in Appendix 4.2.

consider the ULC and ULCN variables below.

Three different types of ULC variables were tried in the regressions, viz., ULWA, ULEOA, ULESA and again on the basis of both $\bar{R}^2$ and the t-ratio they performed worse than WA and ESA for all sectors. There are several possible explanations for the failure of short-run productivity either as a separate variable or when combined with WA, EOA or ESA to form ULC variables. Firstly, it may be simply that short-run productivity does not influence the price level. In the ideal situation where the quality of the data used to represent short-run productivity is not subject to serious question this would be the conclusion which could be drawn from the results. However, this is not the case. As stated in Chapter 4, there are many flaws in the sectoral short-run productivity data which were constructed and it is quite possible that the data used do not measure productivity at all accurately. This would seem to be the conclusion when we consider that in more equations of the form

$$(5.2) \qquad PAi = a + b\ Xi + cPYAi$$

was PYAi significantly positive than it was significantly negative. A third possible reason is that the output data used to calculate PYA should not have been seasonally adjusted. However, this explanation is difficult to accept, especially since prices show little seasonal variation[1] whereas output series exhibit marked seasonal variation. If the poor performance of the short-run productivity

1. See the reference to Pitchford, above p. 98 . Where prices show some seasonal variation (e.g. some food prices) this is more likely to result from seasonal variation in materials prices than in productivity.

variable is at all due to seasonal influences in production it is more likely that the method used to seasonally adjust the production series was unsatisfactory and that not all seasonal movements were removed from the series.

Consider now the ULCN variables used. As in the case of the ULC variables, 3 types of ULCN variables were experimented with, viz., ULNWA, ULNEOA, ULNESA. For equations with ULNWA, $\bar{R}^2$ and the t-ratios associated with the estimated coefficient of the ULNWAi were smaller than those for equations with WA or ESA for all sectors. The same holds for equations with ULNEOA except that the $\bar{R}^2$'s and t-ratios were marginally better than for the ULNWA equations. Of the three ULCN variables tested, ULNESA performed best but performed better than ESA only for sector A5. Hence, on the whole, while the ULCN variables used were more satisfactory than the ULC variables (as would be expected from previous Australian price equation studies), only for sector A5 did they prove superior to ESA.

When UPAi was used as Xi in equations of the form of (5.1) the resulting $\bar{R}^2$'s and t-ratios were better in all sectors than when WA and EOA were used. This was not the case when ESAi is compared with UPAi; ESA gave better results than UPA for some sectors and not for others. It is interesting to note that the equation with UPA for sector A5 was better (in terms of the t-ratio and $\bar{R}^2$) than the equation ULNESA for sector A5. Thus for all sectors of type A the equations with ULC or ULCN variables could be improved by using either WA or ESA or UPA. When PYA was added to the price equations with UPA it was significant and of the right sign only in the equation for sector A5. This reinforces the results obtained previously with productivity. On the whole, the UPA variables were more successful than expected, especially in the light of the simplifying assumptions which were made in order to construct the series.

Turn now to the results obtained using MA. The results using materials cost variables were less conclusive than those obtained using the various labour cost variables. This is probably due to two factors. Firstly, materials costs are likely to be less important than labour costs are in price equations. Secondly, the data used to represent materials costs were, on the whole, less satisfactory than the data used to represent the various labour cost variables. It is felt that these are the main reason for materials cost variables being significant less often than labour cost variables. The relationship between price levels and materials costs was the weakest in the equations for sectors A1 and A2. When the materials cost variable was added to equations with a labour cost variable it was generally insignificant or of the wrong sign for A1 and often insignificant for A2. The relationship was the strongest in the equations for A5, A6 and A7. It will be recalled that for both sectors A5 and A6, two different materials cost variables were proposed.[1] For sector A5 the second materials cost variable, i.e. the one for which the Metals and Coal section of the WPI, linked to the "Price Index of Metallic Materials used in the Manufacture of Fabricated Metal Products" was used, was significant far more often than the first. In fact, the first materials cost variable for sector A5, where significant, was

1. See above pp. 126, 127.

often of the wrong sign. Hence further experimentation with materials costs was confined to the use of the alternative variable. For sector A6 the same appears to be true although the results were not so conclusive.

It will be recalled that a sales tax variable was proposed only for sectors A1 and A7. For both sectors the tax variable proved to be highly significant in nearly all equations in which it was used.

Now consider the results of experimentation with the various demand variables proposed. A general conclusion which can be drawn is that both product market demand variables proposed (i.e. DEXA, DOPA) performed very poorly in all equations and neither of the variables were significant very often. On the other hand, of the labour market demand variables used OTA was significant more often than UA or VA. Since sectoral data were used to represent OTA and aggregate data were used to represent UA and VA, it was decided to use OTA rather than UA or VA in the preferred equations. The remaining labour market demand variables tried were the ratio of VA to UA and the ratio of (VA-UA) to employment (denoted VA*). The results obtained using the ratio of VA/UA were disappointing, but understandable in the light of the results obtained by Higgins using the same variable.[1] On the other hand, those obtained using VA* were more satisfactory and consequently VA* was used in some of the preferred equations to be reported later in this chapter.

Finally, in this section, we will consider the results of

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1. See Higgins, *op.cit.*, p.32.

the limited experimentation carried out with one-period lags. Firstly, consider lagged labour costs. In general, current WA has a larger t-ratio (and was more often significant) than WA_{-1} when both WA and WA_{-1} were included in the same equation. This applies for all sectors except A7 where the results were not clear-cut. Similar results were obtained with ESA although the difference in the significance of ESA and ESA_{-1} was not as clear as for some sectors. Similarly UPA was more often significant than UPA_{-1} when both were included in the same equation except in the equation for sector A5 where UPA_{-1} was more often significant than UPA.

When both MA and MA_{-1} were included in the same equation both were significant in only few cases and on the whole it appears that MA_{-1} is more satisfactory than MA.

5.3. Detailed Results

5.3.1 Sector A1

For sector A1 the most satisfactory labour cost variable was ESA although it was not usually markedly better than WA. The estimated equation of the form of (5.1) where Xi takes the form of ESAi is:

$$(5.3) \qquad PA1 = 51.8239 + \underset{(136.76)}{0.7743}\ ESA1$$

$$\bar{R}^2 = 0.9973 \qquad DWS = 0.83$$

If ESA_{-1} is added to this equation we get:

$$(5.4) \qquad PA1 = \underset{}{51.3782} + \underset{(3.43)}{0.4822\ ESA1} + \underset{(2.08)}{0.3043\ ESA1_{-1}}$$

$$\bar{R}^2 = 0.9974 \qquad DWS = 0.77$$

Comparing these two estimated equations it is obvious that there is strong multicollinearity between ESA1 and $ESA1_{-1}$ since the t-ratio of ESA has fallen dramatically and $\bar{R}^2$ is only slightly higher for the equation with both ESA1 and $ESA1_{-1}$. Note also the decrease in the size of the coefficient of ESA1. Similar results were obtained with WA1 and $WA1_{-1}$ and UPA1 and $UPA1_{-1}$. It will be recalled that the materials cost variable was dropped from the equation for sector A1. If TA1 is added to the above equation ESA_{-1} becomes insignificant while TA1 is significant. The estimated equation is

$$(5.5) \qquad PA1 = 44.6329 + \underset{(4.46)}{0.5285\ ESA1} + \underset{(1.58)}{0.1974\ ESA1_{-1}}$$

$$+ \underset{(4.62)}{0.0985\ TA1}$$

$$\bar{R}^2 = 0.9982 \qquad DWS = 1.08$$

As indicated by the size of the coefficients and the partial correlation coefficients for ESA1 and $ESA1_{-1}$, ESA1 contributes more to the explanation of PA1 and both of these variables are more important than TA1 (when ESA1 and $ESA1_{-1}$ are used separately).

When demand variables were added to equations with ESA1 and/or $ESA1_{-1}$ their coefficient was invariably negative and often significantly negative. This was not the case when they were added to equations with WA or UPA. Therefore, ESA1 was replaced by UPA1 which was only marginally better than WA1 but has the advantage that it also includes materials costs. OTA1 was chosen in preference to VA1* for two reasons - firstly, OTA1 is a sectoral variable while VA1* is an aggregate one; secondly, equations with OTA1 always had better DWS's than the corresponding equations with VA1* although on the basis of $\bar{R}^2$ and the t-ratio there was little difference between OTA1 and VA1*. The equations from which the preferred equation was finally chosen are presented in Table 5.1.[1]

On the basis of the $\bar{R}^2$'s for the equations presented in Table 5.1, the preferred equation would be (5.1e). It should be noted that at best the DWS falls in the inconclusive region thus indicating that there is still some serial correlation in the residuals. It is felt that this may be due to the fact that a materials cost variable is not included and it may be possible to remove this serial correlation by trying alternative materials cost variables. Secondly, it may be due to the fact that a ULC or ULCN variable is not used. It will be recalled that the poor performance of ULCN was felt to be due largely to the poor data used to measure productivity.

5.3.2. Sector A2

For sector A2 there were far less equations with all the variables significant than there were for sector A1. In addition to this, it will be recalled that a sales tax variable was not defined for sector A2. Despite this, the DWS's were, on the whole, far better than those for sector A2.

As regards the labour cost variables, WA was marginally better on the basis of $\bar{R}^2$ and the t-statistic than ESA. This also applied

1. See p. 198.

TABLE 5.1 : SECTOR A EQUATIONS

Equation Number	EQUATION	$\bar{R}^2$	DWS.
5.1 a	$PA1 = 24.8571 + 0.3307\ WA1 + 0.2003\ TA1 + 1.6577\ OTA1$ $(41.95) \quad (8.30) \quad (3.92)$	0.9973	1.38
5.1 b	$PA1 = 24.6746 + 0.2466\ WA1 + 0.0911\ WA1_{-1} + 0.1949\ TA1 + 1.5892\ OTA1$ $(6.07) \quad (2.11) \quad (8.31) \quad (3.88)$	0.9974	1.08
5.1 c	$PA1 = 31.8975 + 0.3087\ UPA1 + 0.1558\ TA1 + 1.2107\ OTA1$ $(45.52) \quad (6.44) \quad (2.95)$	0.9974	1.18
5.1 d	$PA1 = 23.1635 + 0.3653\ UPA1_{-1} + 0.1789\ TA1 + 1.4821\ OTA1$ $(34.97) \quad (6.07) \quad (2.93)$	0.9961	1.45
5.1 e	$PA1 = 29.4501 + 0.2034\ UPA1 + 0.1282\ UPA1_{-1} + 0.1545\ TA1 + 1.2529\ OTA1$ $(6.59) \quad (3.48) \quad (7.09) \quad (3.39)$	0.9979	1.12

to lagged values of these variables. In fact, in estimated equations with either $WA2_{-1}$ and WA2 or $EA2_{-1}$ and EA2, both WA2 and $WA2_{-1}$ are significant while both EA, $EA2_{-1}$ are insignificant. On their own UPA2 and $UPA2_{-1}$ gave better results than WA2 or ESA2 but when both UPA2 and $UPA2_{-1}$ were included in the same equation $UPA2_{-1}$ was not significant.

It will be recalled that MA was not successful in equations for sector A2. Since PA2 is represented by the implicit deflator for final government consumption expenditure, it is not certain whether a demand variable would be relevant. OTA2 was nevertheless included in the regressions and proved to be significant in many cases. It marginally increased the value of $\bar{R}^2$ and also increased the DWS. Some of the more satisfactory equations for sector A2 are given in Table 5.2.[1] It will be noted that in neither case is OTA2 significant at the 5% level, but it is significant at the 10% level. On the basis of both $\bar{R}^2$ and the DWS, equation (5.2d) was chosen as the preferred equation for sector A2.

5.3.3 Sector A3

The results obtained for sector A3 were far from satisfactory. This was evidenced by both the number of variables which were significant and of the right sign and by the DWS. This was all the more surprising when it was found that the results for sector A4 (also a building sector) were far better. It had not been expected that the results for these sectors would differ so much especially as the same

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1. See p. 200.

TABLE 5.2 : SECTOR A2 EQUATIONS

Equation No.	EQUATION	$\bar{R}^2$	DWS.
5.2 a	PA2 = -5.7584 + 0.6993 WA2 (91.94)	0.9940	1.35
5.2 b	PA2 = -0.8137 + 0.6171 UPA2 (105.12)	0.9954	1.58
5.2 c	PA2 = -0.8685 + 0.6908 WA2 + 1.8664 OTA2 (77.52) (1.73)	0.9942	1.45
5.2 d	PA2 = -3.1235 + 0.6106 UPA2 + 1.6168 OTA2 (88.50) (1.70)	0.9956	1.70

data were often used for both sectors.

For sector A3 WA proved to be a better labour cost variable than ESA. This was the case for both current and lagged forms of the labour cost variables. Where both current and lagged labour cost variables were included in the same equation WA3 and $WA3_{-1}$ proved to be both significant while this was not the case for ESA3. When UPA3 was used in the place of WA3 or ESA3 the equations improved slightly in terms of $\bar{R}^2$, the t-ratio and the DWS. In estimated equations of the form:

$$(5.6) \qquad PA3 = \hat{a} + \hat{b}\ MA3$$

$\hat{b}$ was significantly different from zero. However, when MA3 is added to an equation with WA3 it becomes insignificant. Similarly, in all other equations where MA3 is included amongst the regressors it is insignificant. In only one case is $MA3_{-1}$ significant and then only at the 10% level. This was in an equation with WA3. This may be because of the data used to represent MA3. It will be recalled that for sector A3 the Building Materials section of the WPI was linked to the "Price Index of Materials used in House Building" and when the data were evaluated in Chapter 4 some doubt was expressed as to the validity of this procedure. However, a similar procedure was used in the case of sector A4 where the Building Materials section of the WPI was linked to the "Price Index for Materials used in Building Other than House Building" and in this case both MA4 and $MA4_{-1}$ were significant in a number of cases. Hence it is difficult to provide a good explanation of the failure of the materials price variable for sector A3 and it is difficult to believe that the price of dwellings is insensitive to changing building materials costs.

Another disappointing feature of the results obtained for sector A3 was that in nearly all cases where a demand variable was included in the estimated equations its coefficient was of the wrong sign. Where the coefficient was positive it was insignificant and where negative it was often significantly negative. Thus the estimated equations presented below explain the price level for sector A3 only in the terms of labour costs (and materials where UPA3 is used). Equations using WA3 and UPA3 are presented in table 5.3.[1]

Several points will be noted from this table. Firstly, there is again marked multicollinearity between MA3 and $MA3_{-1}$ and between UPA3 and $UPA3_{-1}$. Secondly, the DWS for all equations leaves much to be desired; this is due most probably to the few variables in the equations and to the fact that neither materials cost variables nor demand variables were successful. The poor DWS almost certainly points to the fact that either one or both of these variables ought to be present in the equations and that the reason why they were not significant or of the wrong sign was that the data did not accurately measure the variables they represent. It is difficult to accept that both the demand and the labour cost variables were rejected because they were not relevant. It is of course, also possible that other influences have been omitted which were not tested in this study.

On the basis of the equations presented in Table 5.3 equation (5.3f) was chosen as preferred equation for sector A3.

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1. See p. 203.

TABLE 5.3 : SECTOR A3 EQUATIONS

Equation No.	EQUATION	$\bar{R}^2$	DWS.
5.3 a	$PA3 = 42.8532 + \underset{(90.43)}{0.3616}\ WA3$	0.9938	0.73
5.3 b	$PA3 = 40.6059 + \underset{(84.32)}{0.3811}\ WA3_{-1}$	0.9929	0.65
5.3 c	$PA3 = 42.0034 + \underset{(3.37)}{0.2323}\ WA3 + \underset{(1.88)}{0.1365}\ WA3_{-1}$	0.9941	0.49
5.3 d	$PA3 = 36.8910 + \underset{(96.90)}{0.4214}\ UPA3$	0.9946	0.79
5.3 e	$PA3 = 34.2469 + \underset{(87.46)}{0.4445}\ UPA3_{-1}$	0.9934	0.74
5.3 f	$PA3 = 35.9612 + \underset{(4.0)}{0.2819}\ UPA3 + \underset{(1.97)}{0.1475}\ UPA3_{-1}$	0.9949	0.52

5.3.4 Sector A4

As remarked in the previous subsection, the results obtained for sector A4 were more satisfactory than those obtained for sector A3. As regards labour costs, ESA4 was found to be marginally superior to WA4. However, since the demand variables were again invariably of the wrong sign when included in the equations with ESA4 and/or $ESA4_{-1}$ we will centre our attention on the equations using WA4 and $WA4_{-1}$, where this was not the case. In most cases both WA4 and $WA4_{-1}$ were significant when entered in the same equation and the coefficient and t-ratio of WA4 were larger than those for $WA4_{-1}$, suggesting that the larger part of the adjustment of prices to wage changes is accomplished within the same quarter. This was also the case where ESA4 was used to represent labour costs. The results obtained using UPA4 and $UPA4_{-1}$ were in general similar to those obtained using WA4 and $WA4_{-1}$.

Materials costs were usually significant for sector A4. While MA4 and $MA4_{-1}$ were never both significant in the same equation, in general MA4 had a smaller coefficient and t-ratio than $MA4_{-1}$ suggesting a rather longer lag in the adjustment of prices to materials costs than in the adjustment of prices to labour costs.

Regarding the two demand variables experimented with, both OTA4 and VA4* were generally significant and of the correct sign except when used in equations with ESA4 or $ESA4_{-1}$ as stated above. On the basis of the t-ratio, VA4* was usually better than OTA4. However, when either of the demand variables was introduced into an equation with MA4 or $MA4_{-1}$ the coefficient of the materials cost variable became insignificant. Hence the preferred equation was chosen to include UPA4 since this variable includes the effects of materials costs. Some equations obtained for sector A4 are given in Table 5.4.[1] The last equation in the table was chosen as the preferred equation for sector A4 since all the variables are significant and of the correct sign, and $\bar{R}^2$ and the DWS are slightly higher than for the equation using OTA4 instead of VA4*. It will be noted from this table that the DWS is the highest and $\bar{R}^2$ the lowest when the labour cost variable is used in lagged form. This has also been the case for most other sectors. It would seem to indicate that for this sector the poor DWS for the equations with both current and lagged labour cost variables included does not result from the omission of some systematic influence and that a different estimation method may remove the serial correlation in the residuals. A second point emerging from the table is the apparent contradiction between the indications of the relative importance of current and lagged labour cost variables. However, on the whole, the lagged labour cost variable appears to be more important.

5.3.5 Sector A5

The results for sector A5 were, on the whole, not as satisfactory as those for sector A4. This was evident both from the somewhat lower $\bar{R}^2$'s and, more noticeably, in the DWS's. Besides this, fewer variables were significant.

There was little difference between the results obtained using WA5 and ESA5, in most cases the $\bar{R}^2$'s for equations using WA5 to represent labour costs were similar to those for equations using ESA5 but

1. See pp. 206. 207.

TABLE 5.4 : SECTOR A4 EQUATIONS

Equation Number	E Q U A T I O N	$\bar{R}^2$	DWS.
5.4 a	$PA4 = 24.2913 + \underset{(14.85)}{0.3448}\ WA4 + \underset{(6.21)}{0.2153}\ MA4_{-1}$	0.9983	0.91
5.4 b	$PA4 = 22.1398 + \underset{(22.11)}{0.3630}\ WA4_{-1} + \underset{(4.73)}{0.2160}\ MA4_{-1}$	0.9972	1.81
5.4 c	$PA4 = 24.2871 + \underset{(6.35)}{0.2589}\ WA4 + \underset{(2.19)}{0.0961}\ WA4_{-1} + \underset{(5.87)}{0.2001}\ MA_{-1}$	0.9984	0.95
5.4 d	$PA4 = 33.6381 + \underset{(84.65)}{0.4038}\ WA4 + \underset{(3.39)}{0.7673}\ OTA4$	0.9976	0.86
5.4 e	$PA4 = 31.1208 + \underset{(70.62)}{0.4251}\ WA4_{-1} + \underset{(2.92)}{0.7926}\ OTA4$	0.9965	1.68
5.4 f	$PA4 = 32.7693 + \underset{(5.67)}{0.2699}\ WA4 + \underset{(2.83)}{0.1418}\ WA4_{-1} + \underset{(3.52)}{0.7457}\ OTA4$	0.9979	0.84
5.4 g	$PA4 = 26.9568 + \underset{(95.14)}{0.4688}\ UPA4 + \underset{(4.27)}{0.8573}\ OTA4$	0.9981	1.00
5.4 h	$PA4 = 24.0222 + \underset{(70.62)}{0.4937}\ UPA4_{-1} + \underset{(3.31)}{0.8928}\ OTA4$	0.9965	1.77

TABLE 5.4 : SECTOR A4 EQUATIONS (continued)

Equation Number	E Q U A T I O N S	$\bar{R}^2$	DWS.
5.4 i	$PA4 = 26.1036 + \underset{(7.24)}{0.3401}\ UPA4 + \underset{(2.75)}{0.1365}\ UPA4_{-1} + \underset{(4.44)}{0.8375}\ OTA4$	0.9983	0.91
5.4 j	$PA4 = 34.8277 + \underset{(149.44)}{0.4151}\ WA4 + \underset{(4.14)}{0.0486}\ VA4^{*}$	0.9978	0.93
5.4 k	$PA4 = 32.3027 + \underset{(124.71)}{0.4373}\ WA4_{-1} + \underset{(3.72)}{0.0523}\ VA4^{*}$	0.9968	1.86
5.4 l	$PA4 = 33.8785 + \underset{(6.06)}{0.2682}\ WA4 + \underset{(3.32)}{0.1551}\ WA4_{-1} + \underset{(4.65)}{0.0497}\ VA4^{*}$	0.9982	0.94
5.4 m	$PA4 = 28.0485 + \underset{(168.53)}{0.4835}\ UPA4 + \underset{(5.01)}{0.0521}\ VA4^{*}$	0.9983	1.08
5.4 n	$PA4 = 25.0982 + \underset{(124.88)}{0.5098}\ UPA4_{-1} + \underset{(4.08)}{0.0572}\ VA4^{*}$	0.9968	1.94
5.4 o	$PA4 = 27.0865 + \underset{(7.78)}{0.3361}\ UPA4 + \underset{(3.42)}{0.1558}\ UPA4_{-1} + \underset{(5.67)}{0.0535}\ VA4^{*}$	0.9986	1.01

the DWS was usually somewhat higher for equations using WA5. Further, the use of UPA5 in place of WA5 or ESA5 resulted in a higher $\bar{R}^2$ and DWS and if the estimated equation explaining PA5 in terms of UPA5 is compared with the estimated equation explaining PA5 in terms of WA5 and MA5, $\bar{R}^2$ is slightly higher and the DWS is slightly lower for the former. If ESA5 is substituted for WA5 both $\bar{R}^2$ and the DWS are higher than in the equation using UPA5. Both WA5 and $WA5_{-1}$ are significant when included in the same equation as are UPA5 and $UPA5_{-1}$. However when both ESA5 and $ESA5_{-1}$ are used together neither are significant even at 10%. In the equation where PA5 is explained in terms of WA5 and $WA5_{-1}$, WA5 is significant at the 5% level and $WA5_{-1}$ only at the 10% level. In a similar equation using UPA5 and $UPA5_{-1}$ the opposite is true, i.e., $UPA5_{-1}$ is significant at 5% and UPA5 at 10%. Thus, it would appear that WA5 is more important than $WA5_{-1}$ (this is also indicated by the relative size of the partial correlation coefficients) and that when materials costs are taken into account (as in UPA5) the lagged variable is more important in the explanation of PA5 than the current variable.

When MA5 is added to the equations with labour cost variables both MA5 and $MA5_{-1}$ are significant (when used separately) but are never both significant in the same equation. Also, when MA5 or $MA5_{-1}$ are added to the equation with both WA5 and $WA5_{-1}$, $WA5_{-1}$ becomes insignificant. The appropriate lag for MA5 is difficult to discern especially since MA5 and $MA5_{-1}$ are both insignificant when included in the same equation. In the absence of any clear indication it was decided to use the current form of the materials cost variable in the preferred equation.

When demand variables were added to the equations for sector A5 they proved to be invariably of the wrong sign and have, therefore, been omitted from the preferred equation. Recalling from the discussion in the previous section that short-run productivity was also significant in the equations estimated for sector A5, the choice of a preferred equation for this sector must be made from the following two equations:

$$(5.7) \qquad PA5 = \underset{}{48.1619} + \underset{(38.01)}{0.4435\ UPA5} - \underset{(-3.02)}{0.1052\ PYA5}$$

$$\bar{R}^2 = 0.9886 \qquad DWS = 1.01$$

$$(5.8) \qquad PA5 = 47.8211 + \underset{(16.57)}{0.6536\ ESA5} - \underset{(-3.39)}{0.1203\ PYA5} + \underset{(3.17)}{0.2635\ MA5}$$

$$\bar{R}^2 = 0.9922 \qquad DWS = 1.08$$

On the basis of both $\bar{R}^2$ and the DWS, equation (5.8) was chosen as the preferred equation for sector A5.

5.4.6 Sector A6

For sector A6 better equations were obtained using ESA6 than WA6 on the basis of $\bar{R}^2$, the t-ratio for the variable and the DWS. However, in the equation using both WA6 and $WA6_{-1}$ both were significant (although $WA6_{-1}$ only marginally) while this was not the case for ESA6 where ESA6 was significant and $ESA6_{-1}$ was insignificant. $\bar{R}^2$ and the DWS for equations using UPA6 and $UPA6_{-1}$ fall in between those for the WA equations and the ESA equations. When both UPA6 and $UPA6_{-1}$ are used as regressors, both are significant but $UPA6_{-1}$ only at the

10% level of significance. Using the partial correlation coefficients, the current value of the labour cost variable is more important than the lagged value.

Turning now to the results obtained using materials costs, this variable proved to be insignificant in nearly all equations in which it was used. In the few equations where materials costs were significant, only the lagged value of the variable was significant and then only at the 10% level of significance. This is similar to the results obtained for the other government sector (sector A2). The DWS was, however, substantially lower in the equations estimated for sector A6 than for the equations estimated for sector A2.

Demand variables proved to be significant in many of the estimated equations for sector A6 and on the basis of $\bar{R}^2$, the t-ratio and the DWS there was little basis for choice between OTA6 and VA6*, the partial correlation coefficient indicating that in equations with UPA6 and $UPA6_{-1}$, OTA6 is slightly more important and that in equations with WA6 and $WA6_{-1}$, VA6* is more important. As has previously been the case for sectors where a demand variable has proved significant, when OTA6 or VA6* was introduced into an equation with ESA6 its coefficient was invariably negative but usually insignificantly negative.

As in the case of sector A4, the DWS was the highest for the equations using only the lagged labour cost variable and it fell when both current and lagged variables were included in the same equation. However, for all equations the DWS indicated serially correlated residuals. Some of the better equations obtained for sector A6 are presented in Table 5.5.[1]

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1. See p. 211.

TABLE 5.5 : SECTOR A6 EQUATIONS

Equation Number	EQUATIONS	$\bar{R}^2$	DWS.
5.5 a	$PA6 = 23.4581 + \underset{(102.45)}{0.4821}\ UPA6 + \underset{(4.61)}{1.1498}\ OTA6$	0.9966	0.68
5.5 b	$PA6 = 20.3573 + \underset{(86.62)}{0.5073}\ UPA6_{-1} + \underset{(4.19)}{1.2334}\ OTA6$	0.9953	1.06
5.5 c	$PA6 = 22.4524 + \underset{(5.17)}{0.3316}\ UPA6 + \underset{(2.35)}{0.1589}\ UPA6_{-1} + \underset{(4.87)}{1.1619}\ OTA6$	0.9969	0.44
5.5 d	$PA6 = 25.6637 + \underset{(5.11)}{0.3261}\ WA6 + \underset{(1.93)}{0.1294}\ WA6_{-1} + \underset{(4.08)}{1.1454}\ OTA6$	0.9957	0.37
5.5 e	$PA6 = 28.7338 + \underset{(5.31)}{0.3354}\ WA6 + \underset{(1.93)}{0.1282}\ WA6_{-1} + \underset{(4.24)}{0.0693}\ VA6^*$	0.9958	0.38
5.5 f	$PA6 = 25.3386 + \underset{(4.96)}{0.3348}\ UPA6 + \underset{(2.32)}{0.1651}\ UPA6_{-1} + \underset{(4.08)}{0.0604}\ VA6^*$	0.9966	0.39

The first three equations were included in the table to demonstrate the changes in $\bar{R}^2$ and the DWS which results from adding the current labour cost variable to an equation with the lagged labour cost variable or from adding the lagged variable to an equation with the current variable. The first three equations also demonstrate the ever-present problem of multicollinearity between the current and lagged labour cost variables. Equation (5.5c) was chosen as the preferred equation for sector A6.

5.3.7 Sector A7

Consider now the results obtained for the aggregate sector. In most ways, the aggregate equations were superior to the sectoral equations. Comparing the current labour cost variables used for this sector, the use of ESA7 resulted in marginally better equations than WA7 as regards the t-ratio of the estimated coefficient and $\bar{R}^2$. However, while both WA7 and $WA7_{-1}$ were significant when used together, this was not the case for ESA. When both WA7 and $WA7_{-1}$ were used together the lagged variable proved to have a larger coefficient, t-ratio and partial correlation coefficient indicating that for this sector $WA7_{-1}$ is more important than WA7. This is a somewhat surprising result especially in view of the fact that for most of the sectoral equations the opposite was the case.

When MA7 was introduced into the equation with WA7 and $WA7_{-1}$ all variables are significant. This was also the case of $MA7_{-1}$. However, MA7 and $MA7_{-1}$ were never significant together. An examination of the partial correlation coefficients shows current materials costs to be more important than lagged materials costs so that the current form of the variable was used in the preferred equation for this sector. It should be noted that a UPA series was not constructed for sector A7.

The sales tax variable was significant in all equations in which it was used except when it was included in equations with ESA7 and/or $ESA7_{-1}$. It will be noted that this was not the case for sector A1, the only other sector for which a sales tax rate variable was used.

Both demand variables were significant in most equations in which they were tried with the notable exception of the equations including ESA7. On the basis of the partial correlation coefficients, OTA7 was more important than VA7*.

The preferred equation chosen for sector A7 is

$$(5.9) \quad PA7 = 10.1193 + \underset{(3.04)}{0.1519\ WA7} + \underset{(3.92)}{0.2106\ WA7_{-1}} + \underset{(4.13)}{0.2500\ MA7}$$

$$+ \underset{(2.24)}{0.0660\ TA7} + \underset{(2.88)}{0.8209\ OTA7}$$

$$\bar{R}^2 = 0.9973 \qquad DWS = 1.69$$

5.4 Conclusions

To facilitate a comparison of the preferred equations chosen in the previous section, the preferred equation for each sector is reproduced in Table 5.6.[1] The partial correlation coefficients for each variable are also included in the table (beneath the t-ratio) so that the importance of the explanatory variables may be compared.

1. See pp. 214, 215.

TABLE 5.6 : PREFERRED EQUATIONS

Sector	E Q U A T I O N	$\bar{R}^2$	DWS.
A1	$PA1 = 29.4501 + 0.2034\ UPA1 + 0.1282\ UPA1_{-1} + 0.1545\ TA1 + 1.2529\ OTA1$	0.9981	1.12
t-ratio	(6.59) (3.48) (7.09) (3.39)		
p.c.c.	[0.6892] [0.4489] [0.7152] [0.4398]		
A2	$PA2 = -3.1235 + 0.6106\ UPA2 + 1.6168\ OTA2$	0.9956	1.70
	(88.50) (1.70)		
	[0.9968] [0.2338]		
A3	$PA3 = 35.9612 + 0.2819\ UPA3 + 0.1475\ UPA3_{-1}$	0.9949	0.52
	(3.98) (1.97)		
	[0.4905] [0.2684]		
A4	$PA4 = 27.0865 + 0.3361\ UPA4 + 0.1558\ UPA4_{-1} + 0.0535\ VA4*$	0.9986	1.01
	(7.78) (3.42) (5.60)		
	[0.7434] [0.4390] [0.6287]		
A5	$PA5 = 47.8211 + 0.6536\ ESA5 - 0.1203\ PYA5 + 0.2635\ MA5$	0.9922	1.08
	(16.57) (-3.39) (4.17)		
	[0.9212] [0.4359] [0.5118]		

TABLE 5.6 : PREFERRED EQUATIONS (continued)

Sector	E Q U A T I O N	$\bar{R}^2$	DWS.
A6	$PA6 = 22.4524 + 0.3316\ UPA6 + 0.1589\ UPA6_{-1} + 1.1619\ OTA6$	0.9969	0.44
t-ratio	(5.17) (2.35) (4.87)		
p.c.c.	[0.5941] [0.3183] [0.5711]		
A7	$PA7 = 10.1193 + 0.1519\ WA7 + 0.2106\ WA7_{-1} + 0.2500\ MA7 + 0.0660\ TA7$	0.9973	1.69
	(3.04) (3.92) (4.13) (2.24)		
	[0.4054] [0.4964] [0.5160] [0.3106]		
	$+ 0.8209\ OTA7$		
	(2.88)		
	[0.3873]		

Before considering the results contained in Table 5.6, we will briefly compare the quality of the equations. As mentioned in the previous section, the statistical quality of the equations estimated for sector A7 was on the whole substantially better than that of the equations estimated for sectors A1, ..., A6. This was evidenced by two main facts. In the first place, far more variables were significant and significant together in the equations for sector A7 than was generally the case for the other sectors. Secondly, the DWS for the sector A7 equations was generally much better. It is felt that the more satisfactory nature of the aggregate equations was in large part due to the better data used to measure the aggregate explanatory variables. Unfortunately, it was not possible in this study to re-estimate all the different sectoral equations using aggregate data for the explanatory variables. If this had been possible it is likely that the resulting sectoral equations would have been more satisfactory at least for some sectors. This is also suggested by a comparison of the sectoral equations obtained in this study with the estimated equations reported in the RBA studies. When comparing these it would appear that, on the whole, the attempt to improve the RBA equations by using sectoral equivalents of their aggregate variables and/or experimenting with other variables which have been successfully used in overseas studies has not been successful. Before coming to this conclusion, however, it must be pointed out that since all the price equations reported in Paper 3F have the lagged dependent variable included among the regressors the comparison is not strictly valid. However, given the nature of the sectoral data available, it is quite possible that for some sectors better equations could be obtained using aggregate data for the explanatory variables even if the lagged dependent variable is not included among the regressors.

A second consequence of the difference in the quality of the aggregate and sectoral equations is that a comparison of the preferred sectoral equations with the preferred aggregate equation will be difficult. It is probable that the differences between them are due partly to the differences in the quality of the data used to represent the explanatory variables and partly to the differences in the sectors themselves. With this in mind we will, nevertheless, attempt some comparisons.

If we compare the preferred equations we find that the $\bar{R}^2$'s are satisfactory but that in most cases the DWS's are not. Only for sectors A2 and A7 do the DWS's indicate an absence of serial correlation in the residuals.

Comparing the labour cost variables we find that in most of the equations both the current and lagged labour cost variables are significant. Further, if the partial correlation coefficients of the current and lagged labour cost variables are compared for each equation in which both occur we find that in all the sectoral equations the current labour cost variable is more important than the lagged variable but that in the aggregate equation the opposite is true. In the sectoral equations this appears to be based on fairly strong evidence as shown in the differences in the partial correlation coefficients. However, in the aggregate equation the difference between the partial correlation coefficients is not so large and it would thus appear that the lagged wage rate variable is not substantially more important than the current one. Despite this it would appear that the appropriate lag structure for labour costs in the aggregate equation is not the same as that for the majority of the sectoral equations. It should be noted that all but one of the sectoral equations use UPA to represent labour costs and this variable was not calculated (and thus not used) for sector A7. Hence the change in the relative importance of the current and lagged labour cost variables may be due partly to the influence of materials costs (which are included in UPA) although it is unlikely that the use of UPA rather than WA is the sole reason.

If we examine the partial correlation coefficients to see which of the explanatory variables are the most important in the explanation of prices we find the indications in most of the equations to be somewhat obscured by the presence of multicollinearity between the current and lagged labour cost variables. It will be noted that in the equations for sectors A2 and A5 where only the current form of the labour cost variable is included, labour costs are by far the most important determinant of prices. In the equation for A1, the partial correlation coefficient of TA1 is larger than the partial correlation coefficient of either of the UPA variables. However, if either UPA or UPA_{-1} is used alone the partial correlation coefficient indicates that it is more important than any of the other variables in the equation. The same holds for sector A7 with respect to WA7. Hence it may be concluded that the labour cost variables are in fact the most important determinants of prices.

The performance of the materials cost variable has in general been disappointing but for the two sectors for which the variable was successful, materials costs do appear to be important in the pricing process and more important than demand, productivity and sales tax. They are less important than labour costs (if the type of reasoning advanced in the previous paragraph is accepted). It is somewhat unfortunate that more suitable materials cost series could not be obtained so that a valid comparison could be made of the importance of materials costs for the various sector and of the importance of materials costs in the sectoral equations with their importance in the aggregate equation. It should be noted that the preferred equations which do not have a separate materials cost variable all have UPA variables in which materials costs are included. However, the UPA variable was usually used where the separate materials cost variable was not successful and it is difficult, using the UPA variables, to test for the separate impact of materials costs on prices. Besides this, it will be recalled that because of the unavailability of suitable industrial price indexes, a simplifying assumption was made to make it possible to calculate the unit prime cost series[1] and it is felt that because of this simplifying assumption the resulting unit prime cost series are more a measure of labour costs than they would have been if the assumption had not been made.

Demand variables proved to be important for most sectors although less important than labour costs and, in those sectors for which a materials cost variable was significant, less important than material costs. For sector A7 the influence of demand on the price level proved to be slightly stronger than that of the sales tax rate.

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1. See above, pp. 92, 93 and 136.

Finally, the tax rate proved to be more important for sector A1 than for A7, although this may be influenced by the number of significant variables in the equations. However, the results are in accordance with expectations since, as stated in Chapter 4, sales tax and excise are levied mainly on consumer goods and we would, therefore, expect them to be more important in the sectoral equation explaining the price of final consumption expenditure than in the aggregate equation.

CHAPTER 6

TYPE B RESULTS

6.1 Introduction

Much of what was said in the introduction to the previous chapter is also relevant to this chapter. Firstly, the structure of this chapter will be the same as that of the previous one. Section 6.2 will deal with general results, section 6.3 with more detailed results sector by sector and the final section will contain a brief comparison of the results for each sector on the basis of the preferred equation for each sector.

Secondly, the same restrictions were placed on the experimentation for equations for type B sectors.[1]

Thirdly, the estimation method and test statistics used are the same as those used in the previous chapter.

6.2 General Observations on the Results

Consider firstly, the performance of the labour cost variables tried. On the whole, the relative performance of the labour cost variables was similar to their relative performance in the estimated equations for type A sectors. As in the case of the equations for sectors A1, ..., A7, initial experimentation was carried out using the labour cost variables in equations of the form:

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1. See above p. 186.

$$(6.1) \qquad PBI = \hat{a} + \hat{b}Xi$$

PBi = price level for sector Bi

Xi = labour cost variables for sector Bi

For most labour cost variables lagged values of Xi were also tried. The merits of the labour cost variables were then judged on the basis mainly of $\bar{R}^2$ and the t-ratio associated with $\hat{b}$ and further experimentation was carried out with the equations in which the labour cost variables gave the best results. It is realized that elimination of certain variables in this way is not ideal and that eliminated variables may have performed better if other variables were added to the equations, but some method had to be used to reduce the number of possible explanatory variables, since both time and computer space made the testing of all plausible combinations of variables for all sectors prohibitive. This type of preliminary experimentation was carried out using the following different labour cost variables: WB, EOB, ESB, ULWB, ULEOB, ULESB, ULNWB, ULNEOB, ULNESB, UPB.[1] The preliminary testing resulted in the rejection of the ULC and ULCN variables for reasons similar to those which applied in the case of type A equations. It should be noted that short-run productivity was not calculated for sector B5 and hence ULC and ULCN variables were not tested for this sector. For the remaining sectors, all 3 ULC variables performed poorly on the basis of $\bar{R}^2$ and the t-ratio. In fact, for no sector were $\bar{R}^2$ and the t-ratio associated with the labour cost variables higher for equations with any one of the ULC variables than they were for equations with WB, EOB, ESB or UPB. When short-run productivity (PYB) was

1. For a list of the symbols see Appendix 4.2.

used as a separate variable in equations with WB, WB_{-1}, EOB, EOB_{-1}, or ESB, ESB_{-1} (current and lagged variables being used separately or together), it was significant and of the required sign only 3 times out of 45, and was not consistently so for any one sector. Hence no further experimentation with PYB was carried out. When the ULCN variables were tried in the regressions the results were worse than those obtained in the case of type A sectors. For all type B sectors except sector B4 the ULCN variables were significant in the form of (6.1). For sector B4 ULNWB, ULNESB were significant but had a negative coefficient and ULNEOB was insignificant and had a negative coefficient. In all cases the ULCN variables were inferior on the basis of $\bar{R}^2$ and the t-ratio than WB. Thus we find again that the labour cost variables, when adjusted for short-run or long-run productivity, performed disappointingly especially ULCN which had been most successful in other Australian studies reviewed in Chapter 2 and overseas studies reviewed in Chapter 3. Two factors ought to be noted. Firstly, that where ULCN was used successfully in other studies it was not of the form used here. Hence experimentation with alternative forms of sectoral ULCN variables may reverse the conclusions reached above, at least for some sectors. Secondly, as stated in the previous chapter, the sectoral short-run productivity series calculated in this thesis leave much to be desired and if more accurate series could be devised, the performance of the type of ULCN variables used in this study may be improved.

Let us turn now to the labour cost variables with which further experimentation was carried out, i.e., WB, EOB, ESB and UPB, noting that UPB also covers materials costs so that care will have to be taken when comparing the performance of UPB with that of the other variables mentioned. For type B sectors we again find that equations with WB and ESB were more satisfactory than those with EOB. However, in this case the difference between the performance of EOB and the other two variables was often not as marked as was the case in the equations for type A sectors. Hence it was decided not to reject EOB after the preliminary testing as was done in Chapter 5. A further factor was that while equations with EOB usually had better DWS's than the equations with WB or ESB this was not always the case and again the difference was not as marked. There proved to be little basis for the choice between WB and ESB when $\bar{R}^2$ and the t-ratios were examined but the equations with WB usually had somewhat better DWS's especially for sector B2. When equations with UPB are compared to equations with WB or ESB, the current form of all variables gives very much the same results.

If both the current and lagged values of these labour cost variables are entered as regressors in the same equation, we find that with the exception of EOB, they are not often significant together although they are always significant separately. Hence the problem of multicollinearity made it difficult to draw any firm conclusions as to the relative importance of the current and lagged variables. If both EOB and EOB_{-1} are used in the same equation they are both significant for all sectors but this may result from the fact that neither EOB nor EOB_{-1} provides as good an explanation of prices on its own as WB, WB_{-1}, ESB or ESB_{-1}. If a comparison is made between equations with only a current labour cost variable and equations with only the lagged labour cost variable there is no consistent pattern in the size of the estimated coefficient, $\bar{R}^2$, the t-ratio and the partial correlation coefficient.

Consider now the performance of materials costs. Recall firstly, that suitable materials costs data could not be obtained or constructed for sectors B4 and B5, so that the discussion here will be only relevant to the remaining type B sectors. The materials cost variable was nearly always negative and often significantly negative when added to equations with labour cost variables for sector B1. Since this is unacceptable, MB was not used in further experimentation for this sector. Note that this result for B1 is similar to the result obtained for sector A1 where the materials costs variable was often of the wrong sign. This may well be caused by the materials cost data used to represent the variable. It will be recalled from the discussion in Chapter 4[1] that for both sectors A1 and B1 a weighted average of the prices of various exports was used, the number of goods covered by the index used for sector A1 being somewhat larger than the number of goods covered by the index for B1. If the series constructed for these two sectors[2] are examined, it will be seen that they both fluctuate quite widely and it appears that these fluctuations have not been reflected in the price levels for the two sectors. Two conclusions are possible. Firstly, that the series used to measure materials costs were too narrow and that if more satisfactory series had been used, materials may have been significant and of the correct sign. Secondly, it may be that the prices in these 2 sectors do not

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1. See pp. 123-128 above.
2. See above, Appendix 4.2.

follow very closely the fluctuations in materials prices, or at least, do not follow materials prices when they fall. In sector B6 the coefficient is also sometimes negative, especially when used in equations with WB or WB_{-1}. In sector B2 materials are usually significantly positive, and for sector B3 they are significant only sometimes. For sectors B2, B3 and B6 the best results appear to be obtained when MB is used in conjunction with EOB and/or EOB_{-1}. If a lagged materials cost variable is used instead of a current one, the results generally improve especially when used in equations with EOB. If both MB and MB_{-1} are used in the same equation they are both significant only very rarely.

When considering the sales tax variable it will be recalled that indexes were calculated only for sectors B4, B5 and B6. The variable is significant in all equations with the labour cost variables, both current and lagged and the weakest relationship appears to hold for sector B4.

Turn now to the results obtained using the demand variables. Firstly, consider the preliminary testing carried out. The demand variables used were the two product market demand variables DEXB, DOPB and the five labour market demand variables UB, VB, $^{VB}/UB$, VB*, OTB. Some experimentation was also carried out using lagged UB and VB. Firstly, DOPB proved unsatisfactory, being insignificant in all equations except the equation for B4. In contrast to the results obtained for the type A sectors, DEXB proved to be significant for all sectors and the results obtained for sector B4 were better than those obtained for B4 using DOPB so that no further experimentation was carried out with the change in output as a measure of the strength of demand. As in the case of the type A sectors, most of the labour market demand variables except OTB proved to be insignificant. UB was significant for some sectors but where this was the case the use of OTB and DEXB provided superior equations. The results using VB were similar. Where lagged UB or VB were used it was found that they gave worse results than the corresponding current variable, suggesting that firms respond fairly quickly to change in demand. Neither of $^{VB}/UB$ or VB* proved useful. Both were insignificant in current and lagged form for all sectors. Hence DEXB and OTB proved to be the most successful indicators of demand pressure in the equations for type B sectors and further experimentation with demand variables was confined to these two variables. When these two variables were included in equations with labour cost variables, they proved to be significant in only a few cases - mainly in equations for sector B3. Thus for type B sectors demand variables do not appear to be very successful. This is rather surprising in the light of the results obtained for type A sectors where a demand variable was included in the preferred equations for 5 of the 7 sectors including sector A1 (Private Final Consumption Expenditure). If any reliance is to be placed on the results obtained in the previous chapter, it would appear that while demand is the least important of the explanatory variables it ought to be significant in at least some of the type B equations and that if better measures of demand could be obtained this might be the case.

6.3 Detailed Results

6.3.1 Sector B1

As hinted in the previous section, the results for sector B1 were not very satisfactory. In fact, only labour cost variables were significant and only in the case of EOB were both EOB and EOB_{-1} significant together. On the whole, equations with ESB or ESB_{-1} had the highest $\bar{R}^2$'s and also the highest t-ratio and, as has often been the case in the results described in Chapter 5, the lowest DWS. However, the DWS for all the equations for sector B1 showed strong evidence of positive first order serial correlation in the residuals. Equations with UPB or UPB_{-1} had slightly higher $\bar{R}^2$'s than equations with WB and EOB.

Some discussion has already been presented in the previous section on the performance of the materials cost variable in equations for sector B1 and this will not be repeated in this section. As also stated in the previous section, the results obtained using various demand variables were disappointing. Thus the preferred equation for sector B1 was chosen from amongst those presented in Table 6.1.[1]

From this table equation (6.1 f) was chosen as the preferred equation for sector B1. This equation was chosen because to some extent, UPB1 also includes materials costs. Secondly, the $\bar{R}^2$ associated with this equation was only slightly lower than the best $\bar{R}^2$ (i.e. for (6.1 d)). Thirdly, although its DWS is the lowest in the table (except for equation (6.1 a)), the DWS for all equations shown give strong indication of serial correlation in the residuals so that the value of the DWS did not affect the choice of the preferred equation.

Before proceeding to a discussion of the results obtained for sector B2, let us consider briefly some of the possible causes of the

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1. See p. 229.

TABLE 6.1 : Sector B1 Results

Equation Number	EQUATION	$\bar{R}^2$	DWS.
6.1 a	PB1 = 48.4441 + 0.3281 WB1 (30.87)	0.9492	0.26
6.1 b	PB1 = 58.9090 + 0.6466 EOB1 (29.67)	0.9452	1.06
6.1 c	PB1 = 57.9389 + 0.3784 EOB1 + 0.2881 $EOB1_{-1}$ (4.31) (3.14)	0.9534	0.46
6.1 d	PB1 = 58.2284 + 0.6569 ESB1 (35.08)	0.9602	0.32
6.1 e	PB1 = 57.2613 + 0.6838 $ESB1_{-1}$ (35.04)	0.9601	0.33
6.1 f	PB1 = 44.6942 + 0.3638 UPB1 (33.29)	0.9600	0.30
6.1 g	PB1 = 42.3688 + 0.3840 $UPB1_{-1}$ (32.40)	0.9536	0.33

unsatisfactory results obtained for sector B1. Firstly, the failure of the materials cost variable has already been discussed. In addition to the previous reasons for failure put forward previously, it may be that the components of the EPI used do not measure the prices to Australian manufacturers even of the goods covered by these components, and it appears very likely that if it were possible to construct alternative materials cost series which covered a wider range of materials inputs for sector B1 and measured the prices to Australian manufacturers more accurately, better equations could be obtained for this sector. Secondly, it would appear that certain of the elements covered by the price index for sector B1 are subject to seasonal fluctuations. It may be possible to account for these by a suitably constructed materials cost index or alternatively, better results may be obtained if the influence of these seasonally affected items could be removed from the dependent variable. Thirdly, it may well be that demand is an important influence on the prices of the goods covered by the sector B1 but that the measures of demand tested in this study have been unsatisfactory. Hence, further experimentation with alternative indicators of demand pressure if they can be obtained or constructed may also improve the statistical quality of the equations. Since the problem of poor DWS's is common to the equations for various sectors, this will be dealt with in the final chapter.

6.3.2 Sector B2

For sector B2 it was found that WB and UPB provided the best results for the labour cost variables in terms of $\bar{R}^2$ and the t-ratio. Except for ESB, both current and lagged labour variables were significant when used in the same equation although in the case of UPB, UPB_{-1} was significant only at the 10% level of significance. From the results obtained with the labour cost variables it appears that the current value of the variable is more important than the lagged value. If equations with only one labour cost variable are compared then those with the current value have a higher $\bar{R}^2$ and t-ratio than those with the lagged value of the same variable and similarly, for those cases in which both the current and lagged values appear significantly in the same equation, the estimated coefficient of the current value is larger than the estimated coefficient of the lagged. Hence, the evidence points fairly clearly to the fact that prices adjust fairly quickly to changes in labour costs as measured by the variables used.

The materials cost variable used for sector B2 is usually significant both in current and lagged form although current and lagged MB are never significant when both are used as regressors together. Comparing estimated equations of the type:

$$(6.2) \qquad PB2 = \hat{a} + \hat{b}X2 + \hat{c}MB2$$

with estimated equations of the form:

$$(6.3) \qquad PB2 = \hat{a} + \hat{b}X2 + \hat{c}MB2_{-1}$$

where X2 takes the form of WB, EOB or ESB or lagged values of these variables, we find that in equations with the WB variables the lagged materials cost variable has a higher partial correlation coefficient than the current variable and that in equations with ESB and EOB variables the opposite is true.

It will be recalled that in the preliminary testing, the use of OTB to represent demand pressure for sector B2 provided better results than the use of other demand variables. Hence it was decided to restrict further testing of the influence of demand for B2 to the use of OTB. When OTB was included in the equations with the labour cost and materials cost variables it was usually found to be negative and often significantly negative. Hence a demand variable does not appear in the preferred equation for sector B2. Since a sales tax variable was not tested in the equations for this sector, the preferred equation was selected from amongst those presented in Table 6.2.[1] From these equations number (6.2 c) was chosen as the preferred equation since all the variables are significant at the 5% level and it has the highest $\bar{R}^2$ and DWS.

6.3.3 Sector B3

In sector B3 we again strike the problem which arose in the previous chapter that if EOB or EOB_{-1} are used separately the estimated equation shows strong evidence of negative serial correlation in the residuals. This problem does not disappear if OTB is added to the equation but the DWS drops to satisfactory levels if MB is added to the equations with EOB. In fact, in the equations with EOB, EOB_{-1} and MB or MB_{-1} the DWS suggests positive serial correlation. If equations of the type (6.1) with X3 variously taking the form WB3, $WB3_{-1}$, EOB3, $EOB3_{-1}$, ESB3, $ESB3_{-1}$, UPB3, $UPB3_{-1}$ are compared, we find the equations with ESB or ESB_{-1} usually giving the best results although they are not markedly better than the equations with WB or WB_{-1}. On the other hand, the equations with EOB or UPB (current or lagged) are generally of poorer quality (as regards $\bar{R}^2$ and the t-ratio) than those

1. See p. 233.

TABLE 6.2 : Sector B2 Results

Equation Number	EQUATION	$\bar{R}^2$	DWS
6.2 a	$PB2 = 54.7826 + \underset{(96.95)}{0.3163}\ UPB2$	0.9946	1.18
6.2 b	$PB2 = 54.1637 + \underset{(5.39)}{0.2330}\ UPB2 + \underset{(1.93)}{0.0886}\ UPB2_{-1}$	0.9949	0.87
6.2 c	$PB2 = 55.5427 + \underset{(5.02)}{0.1422}\ WB2 + \underset{(4.86)}{0.1463}\ WB2_{-1} + \underset{(5.27)}{0.0155}\ MB2_{-1}$	0.9976	1.39
6.2 d	$PB2 = 63.3456 + \underset{(7.78)}{0.3500}\ EOB2 + \underset{(4.34)}{0.2046}\ EOB2_{-1} + \underset{(5.19)}{0.0350}\ MB2$	0.9828	0.73
6.2 e	$PB2 = 63.0179 + \underset{(57.52)}{0.5712}\ ESB2 + \underset{(5.23)}{0.3160}\ MB2$	0.9862	0.58

with WB or ESB (current or lagged). UPB was found to provide slightly better results than EOB.

Both MB3 and $MB3_{-1}$ were found to be significant when included separately with WB or EOB (and the lagged equivalents of these variables) but current and lagged materials costs were never significant together. Further, neither current nor lagged materials cost variables proved to be significant in equations with ESB. This also proved to be the case for OTB which was the demand variable used for sector B3, i.e., it was never significant in equations with ESB or ESB_{-1} and neither was it significant in the equation with the current EOB variable.

Finally, when OTB and MB or MB_{-1} were used in the same equation it was never the case that both were significant and of the right sign. Thus the preferred equation for sector B3 was chosen from those presented in Table 6.3.[1]

As can be seen from the table, equation (6.2 a) has the highest $\bar{R}^2$ but only two variables are significant. The equations with OTB do not have as high an $\bar{R}^2$ as those with MB or MB_{-1} with an equivalent number of significant variables. Equation (6.3 c) was chosen because its $\bar{R}^2$ is nearly as high as those for the other equations but since UPB also incorporates materials costs, the equation takes account of wage and materials costs as well as the influence of demand through the demand variable OTB. Since all the equations show evidence of serial correlation in the residuals, the DWS was not taken into consideration in the choice of a preferred equation for this sector.

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1. See p. 235.

TABLE 6.3 : **Sector B3 Results**

Equation Number	E Q U A T I O N	$\bar{R}^2$	DWS.
6.3 a	$PB3 = 31.8757 + \underset{(2.22)}{0.4118}\ ESB3 + \underset{(3.61)}{0.6968}\ ESB3_{-1}$	0.9977	0.54
6.3 b	$PB3 = 18.6709 + \underset{(1.98)}{0.1860}\ WB3 + \underset{(2.96)}{0.2931}\ WB3_{-1} + \underset{(4.24)}{1.7786}\ OTB3$	0.9941	0.43
6.3 c	$PB3 = 14.6861 + \underset{(2.58)}{0.2269}\ UPB3 + \underset{(3.02)}{0.2812}\ UPB3_{-1} + \underset{(5.22)}{2.1925}\ OTB3$	0.9939	0.48
6.3 d	$PB3 = 4.6518 + \underset{(12.07)}{0.3914}\ WB3_{-1} + \underset{(4.04)}{0.3414}\ MB3$	0.9937	0.50
6.3 e	$PB3 = 23.1199 + \underset{(9.04)}{0.5107}\ EOB3 + \underset{(7.88)}{0.4454}\ EOB3_{-1} + \underset{(2.23)}{0.1802}\ MB3$	0.9953	1.06
6.3 f	$PB3 = 4.4968 + \underset{(1.88)}{0.1757}\ WB3 + \underset{(2.07)}{0.2084}\ WB3_{-1} + \underset{(4.38)}{0.3534}\ MB3_{-1}$	0.9942	0.32
6.3 g	$PB3 = 22.2756 + \underset{(9.30)}{0.5199}\ EOB3 + \underset{(7.04)}{0.4493}\ EOB3_{-1} + \underset{(2.05)}{0.1721}\ MB3_{-1}$	0.9952	1.07

6.3.4 Sector B4.

On the whole, the results obtained for sector B4 proved to be less satisfactory than those obtained for sector B3. This was due, at least in part, to the absence of a materials cost variable for this sector. It will be recalled from the discussion in Chapter 4 that a suitable series for MB4 could not be constructed or obtained so that this variable was not tested for this sector. A second factor contributing to the unsatisfactory nature of the equations estimated for this sector is the failure of the demand variables. It will be recalled from the discussion of the preliminary testing in the previous section, that only DEXB and OTB were retained after the initial experimentation with the demand variables and DEXB was used for sector B4. When this variable was further experimented with it proved to have the wrong sign or to be insignificant in all cases and hence does not appear in the preferred equation for this sector. Unfortunately, the quality of the data used to represent the demand variables in this study will prevent the conclusion that the influence of demand is not important in price equations for this sector.

Regarding the results of the experimentation with the labour cost variables, it was found that in equations of the form (6.1) WB and WB_{-1} resulted in the best equations as far as $\bar{R}^2$ is concerned. Further it was found that the use of UPB and UPB_{-1} resulted in better equations than when either EOB or ESB were used and that the improvement in the equation when ESB was substituted for EOB was not very large, certainly not as large as has been the case for certain other sectors. When both current and lagged labour cost variables were included in the same equation, they were both significant only in the case of WB and EOB. In the equation explaining PB in terms of WB and WB_{-1}, WB was significant only at the 10% level. For WB, ESB and UPB the use of the lagged variable resulted in a slightly higher $\bar{R}^2$ than for equations with the current variable and for EOB the opposite was true. In all cases the difference in the $\bar{R}^2$ was only small.

The only other variable tested for sector B4 was the sales tax rate. This variable proved to be significant in all equations in which it was introduced.

The preferred equation for sector B4 was chosen from amongst those presented in Table 6.4.[1] On the basis of both $\bar{R}^2$ and the DWS equation (6.4 a) was chosen as the preferred equation for sector B4. It is noted that the coefficient of the current WB variable is significantly different from zero only at the 10% level of significance and that the coefficient of TB is only just significant at the 5% level.

6.3.5 Sector B5

The results obtained for sector B5 were in many ways similar to those obtained for sector B4, although, on the whole, the statistical quality of the equations obtained was better for sector B5. In the first place, it will be recalled from the discussion of the data in Chapter 4, that suitable data could not be obtained or constructed to represent the materials cost variable for sector B5. Thus, in as far as the price level for sector B5 is sensitive to changes in materials costs, the equations will be deficient in this aspect. Secondly, the demand variable DEXB used for sector B5 proved to be insignificant or

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1. See p. 238.

TABLE 6.4 : Sector B4 Results

Equation Number	EQUATION	$\bar{R}^2$	DWS.
6.4 a	$PB4 = 73.2109 + \underset{(1.79)}{0.0748}\ WB4 + \underset{(2.24)}{0.0995}\ WB4_{-1} + \underset{(1.99)}{0.0166}\ TB4$	0.9843	0.45
6.4 b	$PB4 = 77.8219 + \underset{(4.42)}{0.1877}\ EOB4 + \underset{(3.50)}{0.1556}\ EOB4_{-1} + \underset{(2.29)}{0.0317}\ TB4$	0.9574	0.41
6.5 c	$PB4 = 77.5103 + \underset{(36.81)}{0.3518}\ ESB4 + \underset{(2.49)}{0.0313}\ TB4$	0.9649	0.24
6.5 d	$PB4 = 69.9662 + \underset{(47.66)}{0.2035}\ UPB4_{-1} + \underset{(2.02)}{0.0196}\ TB4$	0.9788	0.41

of the wrong sign in all the equations in which it was used. Again, the quality of the data and the extent of experimentation with alternative demand variables or proxies for the pressure of demand are such that the failure of DEXB to be significant and of the required sign cannot be taken as conclusive evidence that demand plays no part in the determination of the price level in this sector.

The performance of the labour cost variables was in some ways similar to the performance of labour cost variables in the estimated equations for sector B4 discussed above. In the results obtained for sector B5, however, both UPB and ESB proved more satisfactory than WB which, in turn, performed better than EOB (on the basis of $\bar{R}^2$ and the t-ratio). For WB, ESB and UPB the lagged form of the variable resulted in somewhat higher $\bar{R}^2$'s than did the current form of the variables. In the case of EOB the opposite was found to hold. Thus, on balance, the appropriate lag on the labour cost variable appears to be similar for both sectors B4 and B5. When both current and lagged labour cost variables are included in the same equation they are both significant except when ESB is used in which case the current variable is insignificant and the lagged significant.

The only other variable tested for sector B5 was the rate of sales tax which proved to be consistently significant. It always had a higher t-ratio, coefficient and partial correlation coefficient than the tax variable in the equations for sector B4 suggesting that for sector B5 taxes are a stronger influence on the price level than they are for sector B4.

The preferred equation for sector B5 was chosen from amongst those presented in Table 6.5.[1] As can be seen from the results presented in this table, the choice of a preferred equation is a marginal one between equations (6.5 a) and (6.5 d). Equation (6.5 d) was chosen because it has a slightly higher $\bar{R}^2$ and because the two explanatory variables UPB5 and $UPB5_{-1}$ include some measure of materials costs, while equation (6.5 a) does not include any materials cost effect.

6.3.6 <u>Sector B6</u>

As in the case of type A sectors, the equations estimated for the aggregate sector (in this case B6) proved to be somewhat better than those estimated for the majority of the other sectors. In the case of type B sectors, however, the difference in the quality of the equations for the aggregate sector, and those for the other sectors was not as great as in the case of the type A sectors.

Let us consider the labour cost variables first. It should be remembered that UPB was not calculated for the aggregate sector, this also being the case for the aggregate type A sector. The value of $\bar{R}^2$ associated with the equations with WB and similar equations with ESB were very similar. Both WB and ESB provided more satisfactory results than did EOB. For the cases of EOB and WB the lagged form of the variable appeared to be more important than the current form although in the case of WB the difference between the two was only very small. For equations with ESB or ESB_{-1} the opposite was true. As has been the case in the equations for several other sectors, WB and WB_{-1} were significant together as were EOB and EOB_{-1} but ESB and ESB_{-1} were both significant in only one equation and in that case they were both

1. See p. 241.

TABLE 6.5 : Sector B5 Results

Equation Numbers	E Q U A T I O N	$\bar{R}^2$	DWS.
6.5 a	$PB5 = 5.8803 + \underset{(2.96)}{0.1679}\ WB5 + \underset{(3.99)}{0.2400}\ WB5_{-1} + \underset{(9.04)}{0.2840}\ TB5$	0.9966	1.39
6.5 b	$PB5 = 28.3887 + \underset{(7.29)}{0.4151}\ EOB5 + \underset{(7.41)}{0.4603}\ EOB5_{-1} + \underset{(2.65)}{0.1533}\ TB5$	0.9912	0.81
6.5 c	$PB5 = 26.8834 + \underset{(24.07)}{0.8837}\ ESB5_{-1} + \underset{(3.27)}{0.1661}\ TB5$	0.9929	0.72
6.5 d	$PB5 = 7.4482 + \underset{(2.43)}{0.1511}\ UPB5 + \underset{(4.15)}{0.2743}\ UPB5_{-1} + \underset{(7.77)}{0.2472}\ TB5$	0.9967	1.39

significant only at the 10% level of significance (this case being when both MB and TB were included in the equation).

The materials cost variable in current form was significant at the 5% level only in equations with EOB or EOB_{-1} and was significant at the 10% level in some equations with ESB or ESB_{-1}. When MB or MB_{-1} was included in equations with WB and/or WB_{-1} its estimated coefficient was invariably negative or insignificant. The current and lagged forms of MB were never significant together and it was found that the lagged form of MB gave marginally better results than the current form.

As has been the case previously, the tax variable was significant in all cases. In general, the estimated coefficient and the partial correlation coefficient of the tax variable in the equations for sector B6 indicate that it is a less important influence on prices for this sector than for sector B5 but more important than for sector B4.

The demand variable used for sector B6, OTB6, proved to be significant in only very few of the equations in which it was included and where it was significant it was so only at the 10% level.

The preferred equation for sector B6 was chosen from amongst those presented in Table 6.6.[1] Several aspects of the results set out in this table should be noted. Firstly, in the only equation where both ESB and ESB_{-1} appear together, they are both significant only at the 10% level. Hence, this equation was rejected in the search for a preferred equation. Secondly, of the variables MB, TB and OTB, OTB is the least well determined, being significant only at the 10%

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1. See p. 243.

TABLE 6.6 : Sector B6 Results

Equation Number	E Q U A T I O N	$\bar{R}^2$	DWS.
6.6 a	$PB6 = 50.4122 + \underset{(8.58)}{0.3779}\, EOB6 + \underset{(7.43)}{0.3406}\, EOB6_{-1} + \underset{(2.21)}{0.0513}\, MB6$	0.9905	0.79
6.6 b	$PB6 = 49.2139 + \underset{(8.43)}{0.3705}\, EOB6 + \underset{(7.71)}{0.3469}\, EOB6_{-1} + \underset{(2.48)}{0.0644}\, MB6_{-1}$	0.9907	0.79
6.6 c	$PB6 = 32.0985 + \underset{(4.03)}{0.1715}\, WB6 + \underset{(3.17)}{0.1429}\, WB6_{-1} + \underset{(8.03)}{0.1844}\, TB6$	0.9973	0.95
6.6 d	$PB6 = 45.3537 + \underset{(8.37)}{0.3654}\, EOB6 + \underset{(6.51)}{0.3083}\, EOB6_{-1} + \underset{(2.73)}{0.1249}\, TB6$	0.9910	0.95
6.6 e	$PB6 = 31.5177 + \underset{(4.17)}{0.1718}\, WB6 + \underset{(3.15)}{0.1385}\, WB6_{-1} + \underset{(1.94)}{0.6336}\, OTB6 + \underset{(8.11)}{0.1816}\, TB6$	0.9975	1.06
6.6 f	$PB6 = 35.7113 + \underset{(8.27)}{0.3265}\, EOB6 + \underset{(6.20)}{0.2658}\, EOB6_{-1} + \underset{(3.95)}{0.0838}\, MB6 + \underset{(4.12)}{0.1851}\, TB6$	0.9931	1.14
6.6 g	$PB6 = 37.7742 + \underset{(1.74)}{0.2823}\, ESB6 + \underset{(1.93)}{0.3323}\, ESB6_{-1} + \underset{(4.10)}{0.0650}\, MB6 + \underset{(5.44)}{0.1707}\, TB6$	0.9963	0.78
6.6 h	$PB6 = 34.7614 + \underset{(8.06)}{0.3188}\, EOB6 + \underset{(6.69)}{0.2790}\, EOB6_{-1} + \underset{(4.10)}{0.0965}\, MB6_{-1} + \underset{(4.29)}{0.1795}\, TB6$	0.9932	1.13

level in the equation where it was included. This was the case in all the equations in which OTB was included amongst the regressors, i.e., where it was significant it was so only at the 10% level. Hence this variable was also excluded from the preferred equation especially since it was never significant when included with MB6 which appears to be better determined. This reduces the choice of a preferred equation to one between (6.6 f) and (6.6 h) of which (6.6 h) was chosen.

6.4 Conclusions

To facilitate a brief comparison of the preferred equations chosen for the various sectors, they are reproduced together with the partial correlation coefficients in Table 6.7.[1]

As in the case of the type A equations, the results for the aggregate sectors were better in the sense that for this sector more variables were significant and significant together. But, on the whole, the $\bar{R}^2$'s for the estimated equations for the aggregate sector were not noticeably better than for the equations for sectors B1, ..., B5 and the DWS was not always better than for the sectoral equations as evidenced by the preferred equations presented in Table 6.7. This reinforces some conclusions drawn in the previous chapter where it was stated that one of the factors responsible for the better statistical quality of the estimated equations for the aggregate sector was that the data used to represent the aggregate variables was often better than that used to measure the sectoral variables. In the case of type B sectors, this was not in general true since it will be recalled

1. See p. 245.

TABLE 6.7 : Preferred Equations

Sector	EQUATION	$\bar{R}^2$	DWS
B1	$PB1 = 42.3688 + \underset{\substack{(32.40)\\[0.9766]}}{0.3840}\ UPB1_{-1}$	0.9536	0.33
B2	$PB2 = 55.5427 + \underset{\substack{(5.02)\\[0.5828]}}{0.1422}\ WB2 + \underset{\substack{(4.86)\\[0.5703]}}{0.1463}\ WB2_{-1} + \underset{\substack{(5.27)\\[0.6015]}}{0.0155}\ MB2_{-1}$	0.9976	1.39
B3	$PB3 = 14.6861 + \underset{\substack{(2.58)\\[0.3458]}}{0.2269}\ UPB3 + \underset{\substack{(3.02)\\[0.4559]}}{0.2802}\ UPB3_{-1} + \underset{\substack{(5.22)\\[0.5978]}}{2.1925}\ OTB3$	0.9939	0.48
B4	$PB4 = 73.2109 + \underset{\substack{(1.79)\\[0.2477]}}{0.0748}\ WB4 + \underset{\substack{(2.24)\\[0.3048]}}{0.0995}\ WB4_{-1} + \underset{\substack{(1.99)\\[0.2734]}}{0.0166}\ TB4$	0.9843	0.45
B5	$PB5 = 7.4482 + \underset{\substack{(2.43)\\[0.3279]}}{0.1511}\ UPB5 + \underset{\substack{(4.15)\\[0.5100]}}{0.2743}\ UPB5_{-1} + \underset{\substack{(7.77)\\[0.7430]}}{0.2472}\ TB5$	0.9967	1.39
B6	$PB6 = 34.7614 + \underset{\substack{(8.06)\\[0.7584]}}{0.3188}\ EOB6 + \underset{\substack{(6.69)\\[0.6946]}}{0.2790}\ EOB6_{-1} + \underset{\substack{(4.10)\\[0.5093]}}{0.0965}\ MB6_{-1} + \underset{\substack{(4.29)\\[0.5265]}}{0.1795}\ TB6$	0.9932	1.13

that the data used to measure explanatory variables for sector B6 was a weighted average of the sectoral data used for sectors A1 and A3. Hence, if this type of reasoning is correct, we would expect to find the estimated equations for the aggregate type B sector to be not noticeably better as far as the statistical properties are concerned than the estimated equations for the other type B sectors. This was, in general, the case. Except for sector B1 the $\bar{R}^2$'s of the preferred equations indicate that price levels have been satisfactorily explained for type B sectors. As was the case with several of the type A sectors, the size of the DWS leaves much to be desired but since this is a problem common to both type A and type B sectors it will be more fully discussed in the final chapter. Again the problem of multicollinearity has appeared especially where both the current and the lagged value of the same variable appear in the one equation. This will make the parameter estimates and t-ratios somewhat unreliable and will have to be taken into account when the equations are compared.

Comparing the sectoral equations (i.e., those for B1, ..., B5) with the aggregate equation, we find that, as stated previously, the quality of the estimated equations for sector B6 is not noticeably better than that of the equations for the other sectors. Secondly, we find that in all but the equation for B1, both current and lagged labour cost variables appear, although different variables provide a better explanation of price levels for different sectors. We also find that in all the sectoral equations except the equation for B2 lagged labour costs are more important than current labour costs. In the estimated equation for B2 presented in Table 6.7 the opposite is the case. Further, for the aggregate equation the current labour cost variable is also somewhat more important than the lagged one. Thus, even given the limited experimentation carried out with lags in this study, the preferred estimated equations do provide some evidence that the lag structure which is appropriate to the aggregate equation is not necessarily appropriate for any one of the sectoral equations. Similarly, the labour cost variable which produces the best results in the aggregate case may not do so in the sectoral cases.

On the whole, the performance of the materials cost variable (separate from UPC) has been disappointing. It should be recalled, however, that materials costs series could not be obtained or constructed for sectors B4 and B5 and that the equations for these sectors may well have been improved by the addition of appropriate materials cost variables. For those sectors for which materials costs were tried they were not retained in the preferred equations for sectors B1 and B3. For sector B2 the partial correlation coefficient of the materials cost variable is larger than that of either the current or lagged labour cost variables. If only one labour cost variable is included in this equation, however, it becomes far more important than materials costs and while it is clearly unacceptable to add the partial correlation coefficients of the two labour cost variables it does strongly suggest that labour costs are more important than materials costs. In the preferred estimated equation for sector B6 the partial correlation coefficient of the materials cost variable is smaller than the partial correlation coefficients of both current and lagged labour costs so that in this case materials costs are clearly less important on the basis of the partials than labour costs. In the equation for sector B6 materials costs are also slightly less important than the sales tax variable.

The sales tax rate variable was used only for sectors B4, B5 and B6, being retained in the preferred equations for all these sectors. From a comparison of the partial correlation coefficients, it appears that changes in the rate of sales tax are an important influence on prices in sectors B5 and B6 but not in sector B4. For sectors B5 and B6 the tax rate variable was less important than labour costs and for B6 more important than materials costs.

Given the limited experimentation carried out with the demand variables, it is difficult to draw firm conclusions about the importance of the influence of demand on prices for type B sectors. However, the influence of demand, except for sector B3, does not appear to be very important although further experimentation with demand variables could modify this conclusion. For sector B3 the demand variable, OTB, enters the equation with a significant coefficient and the partial correlation coefficient indicates it to be quite important for this sector.

CHAPTER 7

TYPE C RESULTS

7.1 Introduction

The structure of this chapter is very much the same as that of the previous two chapters. Section 7.2 contains a discussion of the regression results in general. The next section (section (7.3)) is devoted to a discussion of the results sector by sector and the concluding section (section (7.4)) compares the preferred sectoral equations one with another and with the preferred aggregate equation.

Restrictions similar to those placed on the experimentation with type A and type B equations were also placed on the experimentation with the type C equations. It should be noted that for type C sectors the number of variables was further reduced because of unavailability of data for some variables, most noticeably for short-run productivity. Hence short-run productivity has not been tried as a separate variable and the ULC and ULCN variables could not be tested for the type C sectors. Further, it will be recalled that for some variables for which only aggregate data were available in the case of type A and type B sectors, sectoral data were available in the case of type C sectors (unemployment, vacancies, average earnings). On the other hand, the materials cost variables was used in the aggregate form in the type C equations whereas it was used in sectoral form for most of the type A and type B sectors. The restriction placed on the experimentation with lags in the type C equations are similar to those placed on the experimentation with lags in the type A and type B equations. Hence for type C sectors we experimented with two labour cost variables, a materials cost variable (these three variables also being tried with one period lags), a tax rate variable and five demand variables.

Finally, the estimation method and test statistics used for the type C equations are the same as those used in the previous two chapters.

7.2 General Observations on the Results

We will consider the labour cost variables first. Recall that only two labour cost variables were experimented with, viz., WC and EOC. The unavailability of suitable productivity data for the States precluded the calculation of ULC and ULCN variables and unit prime cost series were not calculated for geographical sectors. If the performance of current WC and EOC variables are compared on the basis of the t-ratio and $\bar{R}^2$ for the estimated equations of the type:

$$(7.1) \qquad PCi = \hat{a} + \hat{b}Xi$$

where Xi takes the form of either WCi or EOCi we find that for all sectors the use of WC provides better results than does the use of EOC. The difference between equations using WC and EOC are quite clear but usually not large. As has been the case for most other sectors, the equations using EOC have better DWS's than those using WC. If equations of the form (7.1) with Xi taking the form WCi or WCi_{-1} are compared we find that for all sectors the equations with WCi are better than those with WCi_{-1} although in most cases the differences are only marginal. This would suggest that slightly more of the adjustment of prices to changes in wages is achieved in the period of the wage change than in the following period. This is borne out when equations having both current and lagged wage rates are examined where we find that current wage rates are slightly more important on the basis of the partial correlation coefficient than lagged wage rates. Both current and lagged wage rate variables are significant for all sectors except sector C5 where $WC5_{-1}$ is insignificant even at the 10% level of significance. When comparing the performance of current and lagged EOC the same results are obtained except that both EOC and EOC_{-1} are significant together for all sectors including sector C5.

If the equations with a materials cost variable are examined we find that in equations with WC, MC is seldom significant although if TC is also added to the equations MC becomes significant in a number of equations. Further, it was found that MC is more often significant in equations with EOC than it is in equations with WC. Some experimentation was carried out with one and two period lags on MC but it was always found that current MC performed better (on the basis of the t-ratio and $\bar{R}^2$) than MC_{-1} and MC_{-2} and since two materials cost variables were never significant together the equations to be presented later in this chapter contain only the current materials cost variable.

The final cost variable experimented with is the sales tax rate variable and as has been the case previously, it was very seldom insignificant. Where it was insignificant this usually occurred in equations with EOC or EOC_{-1} or both.

Consider now the four demand variables experimented with -

DEXC, OTC, UC, VC. Besides these, some experimentation was also carried out with the ratio of VC to UC but as has been the case previously, this variable was found to be unsatisfactory. If we consider the results of the use of demand variables in general we find that for sector C5 all four demand variables mentioned above were almost always significant and often highly significant. For the other sectors the results were mixed but on the whole DEXC and OTC gave better results than the labour market demand variable UC and VC.

7.3 Detailed Results

7.3.1 Sector C1

For sector C1, equations with WC had higher $\bar{R}^2$'s and t-ratios (for WC) than those with EOC. WC and WC_{-1} both proved to be significant in most equations in which they were both used together, despite the presence of multicollinearity. This was also true of EOC. In the case of EOC, however, the multicollinearity between the lagged and the current variables did not appear to be as strong as in the case of WC since in equations with only one labour cost variable (either current or lagged) the t-ratio for WC or WC_{-1} was always higher than the t-ratio for EOC or EOC_{-1} whereas in equations with both the current and lagged labour cost variable the t-ratios of the EOC variables were usually higher than those for the WC variables.

The materials cost variable proved to be significant in many of the equations for sector C1, whether it was used in equations with WC or in equations with EOC. As mentioned in the previous section, current materials costs were always more important than lagged materials costs and current and lagged materials costs were never significant together. Hence, no equations with lagged materials costs are reported for sector C1. As has been the case for most other sectors discussed previously, the sales tax variable was found to be significant in nearly all equations in which it was used, although in equations with EOC and/or EOC_{-1} it usually has a lower t-ratio than in equations where labour costs are measured by WC and/or WC_{-1}.

Of the demand variables, DEXC was the most successful. In fact, all the other demand variables tried in equations for this sector proved to be either insignificant or of the wrong sign. DEXC proved to be significant only in equations with EOC and/or EOC_{-1}. The best equations obtained for sector C1 are presented in Table 7.1.[1] On the basis of the $\bar{R}^2$'s the two equations which have both current and lagged labour costs are the best (i.e., equations (7.1 a) and (7.1 b)). Because of this and because the partial correlation coefficients indicate that DEXC1 is the least important of the variables reported in Table 7.1, it was decided to exclude the demand variable from the preferred equation. Finally, on the basis of $\bar{R}^2$ equation (7.1 a) was chosen in preference to equation (7.1 b) since the DWS of both these equations indicate serially correlated residuals and hence did not affect the choice.

7.3.2 Sector C2

The equations for sector C2 were generally less satisfactory than those for sector C1 in that there were less equations in which all the variables were significant and the $\bar{R}^2$'s were somewhat lower. As before, WC provided a better explanation of prices than did EOC and

1. See p. 254.

TABLE 7.1 : Sector C1 Equations

Equation Number	EQUATION	$\bar{R}^2$	DWS.
7.1 a	$PC1 = 19.0719 + \underset{(4.54)}{0.1749}\ WC1 + \underset{(4.47)}{0.1809}\ WC1_{-1} + \underset{(3.71)}{0.0594}\ MC1 + \underset{(7.47)}{0.2007}\ TC1$	0.9972	0.94
7.1 b	$PC1 = 34.4808 + \underset{(10.58)}{0.3380}\ EOC1 + \underset{(8.88)}{0.3077}\ EOC1_{-1} + \underset{(6.79)}{0.1263}\ MC1 + \underset{(3.12)}{0.1185}\ TC1$	0.9954	1.17
7.1 c	$PC1 = 27.9070 + \underset{(7.97)}{0.4204}\ EOC1 + \underset{(4.72)}{0.1384}\ MC1 + \underset{(5.15)}{0.2713}\ TC1 + \underset{(2.77)}{0.0080}\ DEXC1$	0.9893	1.65
7.1 d	$PC1 = 26.7520 + \underset{(6.20)}{0.4220}\ EOC1_{-1} + \underset{(4.38)}{0.1459}\ MC1 + \underset{(4.38)}{0.2758}\ TC1 + \underset{(2.52)}{0.0087}\ DEXC1$	0.9862	2.22

the current and lagged forms of each labour cost variable were significant when both were used in the same equation.

Materials cost performed worse than in the case of sector C1. The materials cost variable was never significant and of the correct sign in equations in which labour costs were represented by WC and/or WC_{-1}. The sales tax variable was significant in all equations in which it was used.

The demand variables were also less successful than in the case of sector C1. DEX2 was significant and of the correct sign in only two equations - with EOC and TC and with EOC_{-1} and TC. Of the other demand variables only VC was ever significant and of the right sign and in both equations where this was so (with WC_{-1} and with WC and WC_{-1}) VC was significant only at the 10% level. The better equations obtained for sector C2 are presented in Table 7.2.[1] It will be noted from the table that in the equation where MC is included with WC and WC_{-1} it is significant only at the 10% level. Further, it will be noted that no equations which include a demand variable are presented in the table. Since all demand variables performed very poorly they were excluded from the preferred equation. The last equation in the table, equation (7.2 d), was chosen as the preferred equation.

7.3.3 Sector C3

The results obtained for sector C3 were not on the whole better than those obtained for sector C2. WC again proved more satisfactory than EOC on the basis of $\bar{R}^2$ and the t-ratio and the current and lagged variables were significant together in both cases.

1. See p. 256.

TABLE 7.2 : Sector C2 Equations

Equation Number	EQUATION	$\bar{R}^2$	DWS.
7.2 a	$PC2 = 52.5196 + \underset{(7.32)}{0.3579}\ EOC2 + \underset{(6.03)}{0.3070}\ EOC2_{-1} + \underset{(1.87)}{0.0505}\ MC2$	0.9844	0.70
7.2 b	$PC2 = 31.1379 + \underset{(3.31)}{0.1688}\ WC2 + \underset{(1.98)}{0.1089}\ WC2_{-1} + \underset{(7.62)}{0.2451}\ TC2$	0.9938	0.76
7.2 c	$PC2 = 44.7835 + \underset{(6.96)}{0.3337}\ EOC2 + \underset{(5.08)}{0.2633}\ EOC2_{-1} + \underset{(2.93)}{0.1618}\ TC2$	0.9858	0.85
7.2 d	$PC2 = 35.5258 + \underset{(6.62)}{0.2971}\ EOC2 + \underset{(4.58)}{0.2225}\ EOC2_{-1} + \underset{(3.34)}{0.0825}\ MC2 + \underset{(4.12)}{0.2172}\ TC2$	0.9883	0.93

In contrast to the results obtained for sector C2, the materials cost variable was significant in only two equations estimated for sector C3. As before, the sales tax rate variable proved significant in nearly all equations. The demand variables performed somewhat better in the estimated equations for sector C3 than they did in the equations for sector C2, all demand variables being significant in at least one equation. On the whole, OTC proved to be the most satisfactory of the demand variables tested. The equations from which the preferred equation for sector C3 was chosen are presented in Table 7.3.[1] On the basis of $\bar{R}^2$ and the number of significant variables, equation (7.3 d) was chosen as the preferred equation for sector C3. It was found that if MC3 was added to this equation it was insignificant and of the wrong sign.

7.3.4 Sector C4

If we compare the estimation results for sector C4 with those obtained for sector C3 we find that the demand variables were less successful in the equations for sector C4. As has previously been the case, the use of WC to represent labour costs resulted in equations with higher $\bar{R}^2$'s and t-ratios for the labour cost variable (if WC or WC_{-1} are used separately) than in the case of equations where labour costs are represented by EOC or lagged EOC. Current and lagged labour cost variables were usually both significant when used together irrespective of whether WC or EOC was used.

The materials cost variable, MC, was significant less often than in equations for sector C3 and in only one case was MC significant in an equation where WC was used to represent labour costs. The sales

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1. See p. 258.

TABLE 7.3 : Sector C3 Equations

Equation Number	EQUATION	$\bar{R}^2$	DWS.
7.3 a	$PC3 = \underset{}{41.0672} + \underset{(7.12)}{0.3357}\ EOC3 + \underset{(6.76)}{0.3223}\ EOC3_{-1} + \underset{(4.46)}{0.1971}\ TC3$	0.9914	1.09
7.3 b	$PC3 = 33.8696 + \underset{(7.39)}{0.4646}\ EOC3 + \underset{(5.84)}{0.3468}\ TC3 + \underset{(2.06)}{0.0160}\ DEXC3$	0.9845	1.64
7.3 c	$PC3 = 42.0139 + \underset{(2.89)}{0.1762}\ WC3 + \underset{(2.96)}{0.1905}\ WC3_{-1} + \underset{(2.26)}{0.4392}\ OTC3$	0.9944	0.44
7.3 d	$PC3 = 32.2114 + \underset{(3.77)}{0.1793}\ WC3 + \underset{(2.74)}{0.1396}\ WC3_{-1} + \underset{(5.66)}{0.1602}\ TC3 + \underset{(3.15)}{0.4767}\ OTC3$	0.9966	0.54

tax rate variable was, on the whole, clearly significant. When TC was included in an equation with WC and WC_{-1}, WC_{-1} became insignificant but this was not the case where EOC and EOC_{-1} were used. Hence EOC was used to represent labour costs in the preferred equation. Further, MC was significant more often in equations with EOC than in equations with WC.

Finally, as mentioned above, experimentation with demand variables did not prove very successful. Of the demand variables tried in the equations for sector C4 only DEXC was ever significant and of the right sign and then only in equations with EOC and/or EOC_{-1} and TC. The equations for sector C4 from which the preferred equation was chosen are presented in Table 7.4.[1] In the choice of a preferred equation for sector C4 the equation with the highest value of $\bar{R}^2$ (equation (7.4 b)) was rejected because only the lagged labour cost variable is included[2] and it was found that, on the whole, current labour costs were more important than lagged labour costs. The choice was thus reduced to one between equations (7.4 c) and (7.4 d) of which the former was chosen since in (7.4 d) the demand variable, DEXC, is significant only at the 10% level. Further, if both MC4 and DEXC4 are included in an equation with EOC4, $EOC4_{-1}$ and TC4, DEXC4 becomes insignificant and of the wrong sign.

7.3.5 Sector C5

The results obtained for sector C5 are striking in that all the

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1. See p. 260.
2. Note that if WC4 is substituted for $WC4_{-1}$, MC4 becomes insignificant and if both WC4 and $WC4_{-1}$ are used in this equation MC4 is insignificant and $WC4_{-1}$ is significant only at the 10% level.

TABLE 7.4 : <u>Sector C4 Equations</u>

Equation Number	EQUATION	$\bar{R}^2$	DWS.
7.4 a	$PC4 = 43.5513 + \underset{(5.82)}{0.3670}\ EOC4 + \underset{(3.74)}{0.2534}\ EOC4_{-1} + \underset{(3.73)}{0.1885}\ TC4$	0.9868	1.06
7.4 b	$PC4 = 26.6184 + \underset{(19.14)}{0.2848}\ WC4_{-1} + \underset{(2.11)}{0.0402}\ MC4 + \underset{(7.25)}{0.2499}\ TC4$	0.9939	1.16
7.4 c	$PC4 = 34.7087 + \underset{(5.46)}{0.3246}\ EOC4 + \underset{(3.39)}{0.2148}\ EOC4_{-1} + \underset{(3.15)}{0.0774}\ MC4 + \underset{(4.91)}{0.2428}\ TC4$	0.9889	1.21
7.4 d	$PC4 = 40.9123 + \underset{(4.92)}{0.3272}\ EOC4 + \underset{(2.71)}{0.2003}\ EOC4_{-1} + \underset{(4.02)}{0.2519}\ TC4 + \underset{(1.65)}{0.0145}\ DEXC4$	0.9873	1.17

four demand variables experimented with for type C sectors were significant far more often than for any of the other sectors. Of the two labour cost variables used, WC again gave better results than EOC if only the lagged or current variable was used but when both WC and lagged WC were included in the same equation WC_{-1} was often insignificant. This was not the case when current and lagged EOC were used in the same equation.

The materials cost variable was reasonably successful although it was only seldom significant when used in equations with WC and/or WC_{-1}.

As has previously been the case, the sales tax rate variable was consistently significant although when used in equations with a demand variable it was on occasions only significant at the 10% level of significance.

Of the demand variables experimented with DEXC was most often significant, while UC and VC were significant least often. In the equations estimated which included one of the demand variables DEXC was more often significant in equations with EOC and the three labour market demand variables were more often significant in equations with WC and/or WC_{-1}. On the basis of the partial correlation coefficients in equations with only labour cost and demand variables, it appears that where the labour cost variable takes the form of WC, VC is the most important demand variable and where labour costs are represented by the earnings variable, DEXC appears to be the most important of the demand variables.

The preferred equation for sector C5 was chosen from amongst those presented in Table 7.5.[1] Several points should be noted from the table. Firstly, if labour costs are represented by EOC then current labour costs are more important than lagged labour costs whereas if WC is used to represent labour costs then lagged labour costs are more important than current labour costs. Secondly, MC was not included in equations (7.5 e) and (7.5 f) since in both of these equations MC is insignificant (and becomes negative) and if MC is included TC also becomes insignificant (although it is still positive). In the choice of a preferred equation (7.5 e) and (7.5 f) were eliminated because in both equations TC is significant only at the 10% level and MC was insignificant when added to these equations. Secondly, equation (7.5 g) was eliminated because if it is compared to equation (7.5 b) DEXC appears to be a better measure of demand pressure. Hence the choice is between equations (7.5 b) and (7.5 c) of which the latter was chosen.

7.3.6 Sector C6

On the whole, the results obtained for sector C6 were better than those obtained for sectors C3 and C4 but not as good as those obtained for sector C5. In the case of sector C6 equations, the use of WC to represent labour costs generally resulted in equations with higher $\bar{R}^2$'s than when EOC was used to represent labour costs. If estimated equations of the form (6.1) when X6 takes the form of WC6, $WC6_{-1}$, EOC6 or $EOC6_{-1}$ are examined we find that on the basis of $\bar{R}^2$ and the t-ratio (and hence the partial correlation coefficient) the current variable gives marginally better results than the lagged

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1. See p. 263.

TABLE 7.5 : <u>Sector C5 Equations</u>

Equation Number	EQUATION	$\bar{R}^2$	DWS.
7.5 a	$PC5 = 40.8670 + \underset{(7.75)}{0.3084}\ EOC5 + \underset{(5.86)}{0.2532}\ EOC5_{-1} + \underset{(3.04)}{0.0716}\ MC5 + \underset{(3.82)}{0.1849}\ TC5$	0.9891	0.79
7.5 b	$PC5 = 44.9476 + \underset{(5.06)}{0.2569}\ EOC5 + \underset{(3.88)}{0.2027}\ EOC5_{-1} + \underset{(5.04)}{0.0975}\ MC5 + \underset{(3.02)}{0.1338}\ TC5 + \underset{(3.05)}{0.0354}\ DEXC5$	0.9928	1.42
7.5 c	$PC5 = 33.6788 + \underset{(3.00)}{0.1415}\ WC5 + \underset{(3.52)}{0.1703}\ WC5_{-1} + \underset{(2.11)}{0.0383}\ MC5 + \underset{(3.07)}{0.0936}\ TC5 + \underset{(9.30)}{1.1923}\ OTC5$	0.9967	1.18
7.5 d	$PC5 = 40.1072 + \underset{(5.27)}{0.2765}\ EOC5 + \underset{(4.47)}{0.2378}\ EOC5_{-1} + \underset{(4.78)}{0.1211}\ MC5 + \underset{(3.06)}{0.1419}\ TC5 + \underset{(2.07)}{0.4565}\ OTC5$	0.9921	1.19
7.5 e	$PC5 = 35.6342 + \underset{(2.62)}{0.1518}\ WC5 + \underset{(3.88)}{0.2359}\ WC5_{-1} + \underset{(1.73)}{0.0680}\ TC5 - \underset{(-6.64)}{0.0005}\ UC5$	0.9950	0.98
7.5 f	$PC5 = 37.0187 + \underset{(3.51)}{0.1698}\ WC5 + \underset{(3.62)}{0.1800}\ WC5_{-1} + \underset{(1.87)}{0.0595}\ TC5 + \underset{(9.19)}{0.0010}\ VC5$	0.9965	1.23
7.5 g	$PC5 = 42.2360 + \underset{(5.75)}{0.2938}\ EOC5 + \underset{(4.65)}{0.2488}\ EOC5_{-1} + \underset{(4.83)}{0.1057}\ MC5 + \underset{(2.66)}{0.1279}\ TC5 + \underset{(1.95)}{0.0003}\ VC5$	0.9921	1.25

variable. This fact is also borne out where both the current and lagged variables are used in the same equation in which case the estimated coefficient and the t-ratio of the estimated coefficient of the current labour cost variable are larger (although not much larger) than those of the lagged variable.

The materials cost variable was found to be significant in equations with WC and/or WC_{-1} unless TC was also included in the equation. In some cases it was also marginally significant in equations with WC and UC. MC was more often significant in equations where the labour cost variable took the form of EOC.

As has been the case in the estimated equations for all other type C sectors, the sales tax rate variable was always significant and as stated above, the inclusion of the sales tax variable often improved the t-ratio of the materials cost variable.

While all four demand variables were successful to some extent, it was found that VC was the most successful. OCT was significant in only two equations - once with only $EOC6_{-1}$ and once with $EOC6_{-1}$ and MC6. UC was significant in more cases but often only at the 10% level of significance. DEXC was also found to be significant in more equations than OTC. In some equations where the influence of demand was measured by VC, TC became insignificant at the 5% level but was still significant at the 10% level. The best equations obtained for sector C6 are presented in Table 7.6.[1] If EOC_{-1} is included in equation (7.6 c) DEXC becomes insignificant. Since this was not the case where demand was represented by VC, VC was chosen rather than DEXC in the preferred

1. See p. 265.

TABLE 7.6 : Sector C6 Equations

Equation Number	EQUATION	$\bar{R}^2$	DWS.
7.6 a	$PC6 = 31.8334 + 0.1578\ WC6 + 0.1340\ WC6_{-1} + 0.0460\ MC6 + 0.1810\ TC6$ (3.39) (2.74) (2.49) (5.17)	0.9939	0.98
7.6 b	$PC6 = 40.8670 + 0.3084\ EOC6 + 0.2532\ EOC6_{-1} + 0.0716\ MC6 + 0.1849\ TC6$ (7.75) (5.86) (3.04) (3.82)	0.9891	0.79
7.6 c	$PC6 = 34.0641 + 0.4063\ EOC6 + 0.0862\ MC6 + 0.3025\ TC6 + 0.0697\ DEXC6$ (8.81) (2.63) (5.46) (1.67)	0.9823	1.53
7.6 d	$PC6 = 43.4767 + 0.1625\ WC6 + 0.1910\ WC6_{-1} + 0.0427\ MC6 - 0.0006\ UC6$ (2.97) (3.39) (1.82) (-2.52)	0.9915	0.80
7.6 e	$PC6 = 55.1712 + 0.3614\ EOC6 + 0.3240\ EOC6_{-1} + 0.0673\ MC6 - 0.0005\ UC6$ (8.94) (7.67) (2.41) (-1.95)	0.9868	0.65
7.6 f	$PC6 = 34.2485 + 0.1539\ WC6 + 0.1568\ WC6_{-1} + 0.0449\ MC6 + 0.1184\ TC6 + 0.0013\ VC6$ (3.61) (3.46) (2.66) (3.15) (3.19)	0.9949	1.24
7.6 g	$PC6 = 45.6884 + 0.3294\ EOC6 + 0.2864\ EOC6_{-1} + 0.0675\ MC6 + 0.0958\ TC6 + 0.0017\ VC6$ (8.78) (6.88) (3.09) (1.77) (2.96)	0.9907	0.88

equation for sector C6. Similarly, if TC is added to equation (7.6 d), UC becomes insignificant. The same happens if TC is added to equation (7.6 e). Hence, the choice of a preferred equation was reduced to one between equations (7.6 f) and (7.6 g) of which (7.6 f) was chosen since it has both a higher $\bar{R}^2$ and a higher DWS.

7.4 Conclusions

As has been the practice in the previous two chapters the preferred equation for each sector is reproduced in Table 7.7[1] to facilitate a comparison of the preferred equations sector by sector. It will be recalled from the discussion in Chapter 4 that the dependent variable for the aggregate type C sector and the dependent variable for the aggregate type B sector are identical. Hence, the preferred equation for sector B6 (the aggregate type B sector) is included in Table 7.7 as the preferred equation for sector C7. The partial correlation coefficient for each variable in the table is also included.

If the sectoral equations are compared with the aggregate equation we find that, as was the case for type B sectors, the statistical quality of the aggregate equation was not, on the whole, noticeably better than that of the sectoral equations. Since there is no reason to believe that the quality of the data used for sector C7 is better or worse than the quality of the data used for sectors C1, ..., C6 this observation provides further evidence in favour of the argument advanced previously, that the higher statistical quality of the aggregate type A equations compared with that of the sectoral type A equations was, at least in part, due to the difference in the quality of the data

1. See pp. 267, 268.

TABLE 7.7 : PREFERRED EQUATIONS

Sector	EQUATIONS	$\bar{R}^2$	DWS.
C1	$PC1 = 19.0719 + \underset{\substack{(4.54)\\ [0.5481]}}{0.1749}\ WC1 + \underset{\substack{(4.47)\\ [0.5421]}}{0.1809}\ WC1_{-1} + \underset{\substack{(3.71)\\ [0.4721]}}{0.0594}\ MC1 + \underset{\substack{(7.47)\\ [0.7332]}}{0.2007}\ TC1$	0.9972	0.94
C2	$PC2 = 35.5258 + \underset{\substack{(6.62)\\ [0.6908]}}{0.2971}\ EOC2 + \underset{\substack{(4.58)\\ [0.5515]}}{0.2225}\ EOC2_{-1} + \underset{\substack{(3.34)\\ [0.4343]}}{0.0825}\ MC2 + \underset{\substack{(4.12)\\ [0.5111]}}{0.2172}\ TC2$	0.9883	0.93
C3	$PC3 = 32.2114 + \underset{\substack{(3.77)\\ [0.4780]}}{0.1793}\ WC3 + \underset{\substack{(2.74)\\ [0.3678]}}{0.1396}\ WC3_{-1} + \underset{\substack{(5.66)\\ [0.6327]}}{0.1602}\ TC3 + \underset{\substack{(3.15)\\ [0.4139]}}{0.4767}\ OTC3$	0.9966	0.54
C4	$PC4 = 34.7087 + \underset{\substack{(5.46)\\ [0.6190]}}{0.3246}\ EOC4 + \underset{\substack{(3.39)\\ [0.4395]}}{0.2148}\ EOC4_{-1} + \underset{\substack{(3.15)\\ [0.4139]}}{0.0774}\ MC4 + \underset{\substack{(4.19)\\ [0.5782]}}{0.2428}\ TC4$	0.9889	1.21
C5	$PC5 = 33.6788 + \underset{\substack{(3.00)\\ [0.4009]}}{0.1415}\ WC5 + \underset{\substack{(3.52)\\ [0.4568]}}{0.1703}\ WC5_{-1} + \underset{\substack{(2.11)\\ [0.2942]}}{0.0383}\ MC5 + \underset{\substack{(3.07)\\ [0.4087]}}{0.0936}\ TC5 + \underset{\substack{(9.30)\\ [0.8049]}}{1.1923}\ OTC5$	0.9967	1.18

TABLE 7.7 (continued) : Preferred Equations

Sector	EQUATION	$\bar{R}^2$	DWS.
C6	$PC6 = 34.2485 + 0.1539\ WC6 + 0.1568\ WC6_{-1} + 0.0449\ MC6 + 0.1184\ TC6 + 0.0013\ VC6$ (3.61) (3.46) (2.66) (3.15) (3.19) [0.4659] [0.4506] [0.3617] [0.4175] [0.4219]	0.9949	1.24
C7	$PC7 = 34.7614 + 0.3188\ EOC7 + 0.2790\ EOC7_{-1} + 0.0965\ MC7_{-1} + 0.1795\ TC7$ (8.06) (6.69) (4.10) (4.29) [0.7583] [0.6946] [0.5093] [0.5265]	0.9932	1.13

used for the type A sectors. A comparison of the equations in Table 7.7 shows further that equations where labour costs are represented by WC rather than EOC have a higher $\bar{R}^2$. This was generally true for all sectors. Despite this, EOC was used to represent labour costs in some of the preferred equations because in some cases WC and WC_{-1} were not significant together while EOC and EOC_{-1} were and it was often found that more variables were significant in equations with EOC than was the case in equations with WC. As has been the case for most of the other sectors, the $\bar{R}^2$'s of the preferred type C equations are satisfactory but the DWS's are not.

Consider now the labour cost variables. All the preferred equations have both current and lagged labour cost variables. The partial correlation coefficients for the labour cost variables show that in all but one case (sector C5) current labour costs are more important than one period lagged labour costs. In the equation for sector C5 lagged labour costs are more important than current labour costs although the difference between the two partial correlation coefficients is not large. In fact, in the estimated equation for this sector in which only WC and WC_{-1} are used as regressors, the current labour cost variable proves to be more important than the lagged one, the lagged labour cost variable in this case being insignificant. It will be noted that the difference between the partial correlation coefficient of the current labour cost variable and the partial correlation coreefficient of the lagged labour cost variable is greater in the equations where labour costs are measured by EOC than in the equations where they are measured by WC. On the whole, it appears that with the possible exception of sector C5 current labour costs are more important than lagged labour costs and concerning this aspect of the equations the estimated aggregate equation provides a clear indication of the appropriate lags for the sectoral equations. This is not true with respect to the appropriate type of labour cost variable when we see that EOC is used in the aggregate equation and in some of the sectoral equations and WC is used in the other preferred sectoral equations.

Considering the performance of the materials cost variable, it will be recalled from the discussion in section 7.2 that the preliminary testing with one and two period lags on MC showed that current materials costs were more satisfactory for all the sectoral type C equations and that current and lagged materials cost variables were not significant together. Hence, where MC appears in the preferred sectoral equations it appears in its current form. It will be seen that a materials cost variable appears in all the equations except the equation for sector C3. In all cases it is significant at the 5% level and the partial correlation coefficient of MC is always less than the partial correlation coefficient of either of the labour cost variables, indicating that materials costs are definitely less important in the determination of prices than are labour costs. Further, in all equations where MC is significant it is less important on the basis of the partial correlation coefficients than the sales tax rate variable.

Turning now to the tax rate variable, we find that it enters each of the preferred equations significantly. In fact, in all equations in which a tax rate variable has been used it has been found that the labour cost variable and the tax rate variable are the most consistently significant. Considering the somewhat crude method by which an excise rate series has been obtained and the rather large weight of this series in the constructed sales tax and excise data, it would appear that changes in sales tax and excise are clearly reflected in price changes. In the three equations in which both TC and a demand variable were used there is no consistent pattern as to which is the most important - for sector C3 TC has the largest partial correlation coefficient whereas for sectors C5 and C6 the opposite is true. Further, if the importance of TC is compared with the importance of the labour cost variable the results are somewhat obscured by the existence of multicollinearity between the current and lagged labour cost variables. However, if only one labour cost variable is used in each equation (i.e., either the current or the lagged) labour costs prove to be more important than taxes in the determination of prices.

Finally, consider the demand variables. Only for sector C5 were all demand variables significant in nearly all the types of equations estimated. Hence, for this sector there is unambiguous evidence that the influence of demand on prices is important. If the partial correlation coefficients for the variables in the preferred equation for sector C5 are examined we find that demand is more important than the sales tax and excise variable and the materials cost variable. If only one labour cost variable is used in this equation (i.e., either WC5 or $WC5_{-1}$) demand is substantially less important than labour costs. For sector C3 the demand variable (OTC3) is less important than the tax rate variable and the labour cost variable and for sector C6 it is marginally more important than the tax rate variable and less important than labour costs.

CHAPTER 8

CONCLUSIONS

8.1 Introduction

In Chapter 1 we stated that the primary aim of this study was to estimate sectoral price equations for Australia using quarterly data for the period 1960-61 to 1972-73. The secondary aim was stated to be to use these estimated sectoral equations to answer some questions posed in section 1.1 of that chapter. After a brief review of the most important Australian and overseas sectoral price determination studies (Chapters 2 and 3) and a rather lengthy discussion of the data used for the regression analysis (Chapter 4) it was decided that three possible types of disaggregation could be used for an Australian study given the data which were available or which could be constructed. Since there was little indication from the studies reviewed as to which of the possible types of disaggregation would be most useful, it was decided to use all three types of disaggregation. The estimated sectoral price equations based on these three types of disaggregation were presented in Chapters 5-7 and hence the primary aim has been accomplished. It is the purpose of this concluding chapter to attempt to accomplish the secondary aim, viz., to use the estimated equations presented in the previous three chapters to answer some questions concerning the process of price determination in Australia.

Before these questions are considered some comments will be made on two statistical problems which often occurred in the study, viz., multicollinearity and serially correlated residuals. A discussion of these two problems is contained in section 8.2. Section 8.3 deals with the questions posed in Chapter 1 and the final section (section 8.4) offers some suggestions for further work in this area of sectoral price determination.

8.2 Statistical Problems

8.2.1 Multicollinearity

The problem of multicollinearity was found to be worst between current and lagged labour costs. Since the presence of multicollinearity makes for unreliable parameter estimates it was expected that the lag patterns would be difficult to discern in equations of the type used here (i.e., price *level* equations). However, since only one period lags on the labour cost variables were experimented with, in most cases the relative importance of current and lagged labour costs could be gauged from the estimated equations despite the presence of multicollinearity. However, the relative importance of labour cost variables and other influences on prices were difficult to discern in many cases, especially since the partial correlation coefficients of the labour cost variables which were used as a measure of the importance of these variables were also affected by multicollinearity.[1] The presence of multicollinearity also made it difficult to distinguish the lag pattern on the materials cost variables.

There are two methods by which the problem of multicollinearity *may* be reduced to some extent. Firstly, extraneous information may

1. See the note above, p. 188, on partial correlation coefficients and the reference to Theil.

be used. For example, if there is strong multicollinearity between materials prices and labour costs in price equations, unit prime costs may be calculated by the use of the input-output method. This approach has been used with some success in this study where the calculated UPC series were often to be found in preferred sectoral equations. Again with respect to the multicollinearity between current and lagged variables used in the same equation, a lag pattern may be imposed on the variable (e.g., on the wage rate variable) *a priori* and the resulting equation estimated by econometric techniques. The simplest way of doing this is to impose a geometric lag on one or more of the explanatory variables and, using a Koyck transformation, to obtain an equation with the lagged dependent variable on the right-hand-side. This method has not been used in this study for reasons discussed previously.[1]

A second possible approach to the multicollinearity problem is to estimate the price equations in the first-difference form. However, Kmenta warns that if the disturbances in the original model are independent, the transformation to first differences

> "... introduces autoregression in the disturbances that are otherwise independent. As noted, autoregression has undesirable consequences for the properties of the least squares estimators. This makes working with first differences instead of the original data a dubious practice." [2]

The use of first differences also has the danger of magnifying observation errors in the data. It was because the relative importance of these statistical problems was not known in advance that the equations in this study were estimated in level form.[3] It is felt, however,

1. See pp. 82, 83 above.
2. Kmenta, *op.cit.*, pp. 390-391.
3. See the discussion above, pp. 71, 72.

that some additional information concerning the parameters may be gained by estimating price equations of the type estimated in this study in the first difference form especially if the results of the estimated first difference equations are closely compared with the estimated price level equations.

8.2.2 Serially Correlated Residuals

The second statistical problem to be commented on is the problem of serially correlated residuals as evidenced by the usually poor DWS's obtained for the equations estimated in this study. The poor DWS's could be caused in many cases by the omission of a variable which ought to have been included.[1] It is felt that in many of the equations this may well be the case and that the use of unsatisfactory sectoral data has on several occasions led to the rejection of variables which ought not to have been rejected. Comparison between the estimated type A equations obtained in this study and similar equations obtained in the RBA studies which use mostly aggregate data, suggest that the difficulty in question may have been especially important in relation to the sector A equations.

If the results obtained by Eckstein and Fromm (1968) are examined it can be seen that in all cases reported in their study the addition of the lagged dependent variable to the explanatory variables in price level equations significantly improves the DWS. Since this is the only study reviewed in this thesis to present both types of equations we may presume on the basis of this rather meagre evidence that the inclusion of the lagged dependent variable on the right-

1. See Kmenta, *op.cit.*, Ch. 8, section 8.2.

hand-side of the equations would significantly improve the DWS at least for some sectors. However, to include the lagged dependent variable amongst the regressors with the sole purpose of improving the DWS appears very unsatisfactory and is therefore not advocated in the section of this chapter dealing with suggestions for further work. The study by Eckstein and Fromm further indicates that the use of first differences rather than price levels may improve the DWS's (contrary to Kmenta's expectations) so that if first difference equations were to be estimated in an attempt to obtain better estimates of the parameters as cautiously suggested above, the DWS's may well improve also.

Despite this, it is likely that the most satisfactory method of improving the DWS's is firstly to attempt to improve the data used for the regressions so that certain variables may be accepted or rejected with more confidence and secondly to give special attention to those sectors for which the estimated equations are the least satisfactory in an attempt to determine whether there are special features of these sectors which ought to have been taken into account but which were not. In this sense, the results obtained in this study are only of a preliminary nature. Thirdly, it is quite possible that further experimentation with lags will improve the estimated equations provided that this approach does not stumble on the problem of multicollinearity.

8.3 Conclusions

Having discussed the two recurring statistical problems in the previous section let us now turn to the questions which were posed in Chapter 1. In this section we will first compare the determinants of prices for different sectors (including the aggregate sector) and then compare the lags for different sectors. Before this is proceeded with, however, a note of caution must be sounded. As explained in previous chapters, such a comparison will be difficult to make because of the unsatisfactory nature of the data used for many of the sectoral explanatory variables. Since it does not appear possible to distinguish between the case where a variable has been rejected because of the poor data used to measure it and the case where the variable has been rejected because it does not influence the price level in that sector and further, since these cases are not necessarily always distinct, the conclusions reached will necessarily be somewhat tentative - we shall have to be satisfied with rather broad conclusions.

If the results for the three types of disaggregation are compared it appears that the greatest difference between the sectoral equations and between the sectoral equations and the aggregate equations occur for type A and type B disaggregations. However, for all types of disaggregation the size of the estimated parameters and the types of variables appearing in the preferred estimated equations differ quite widely. Thus it would appear that the answers to the first two questions posed in Chapter 1[1] should both be in the affirmative. However, for all sectors it seems fairly clear that labour costs are the most important influence on price levels. In this sense the determinants are not greatly different. They do differ in the types of variables found to represent labour costs most satisfactorily. The

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1. i.e., (1) Do the determinants of sectoral prices differ from sector to sector?
   (2) Do the determinants of sectoral prices differ from those of aggregate prices?

order of the importance of the other variables is not so clear and, even allowing for the deficiencies of the data used it seems that, apart from labour costs, there is substantial variation in the relative importance of the remaining variables used. Even for the type C equations where the importance of the variables does not differ as much as for the other two types of sectors, there are differences in the relative importance of certain variables amongst the equations. There are probably two reasons why there is less variation in the type C results than in the type A and type B results. Firstly, this would be expected *a priori* since there is likely to be less variation in economic structure between States than between final demand or consumer sectors. Secondly, the quality of the data is likely to be more uniform. However, it is unlikely that either of the causes should carry sole responsibility.

Thus as regards the first two questions posed in Chapter 1 it appears that the determinants of prices do differ from sector to sector especially in the case of type A and type B sectors so that price determination can be more adequately understood by examining sectoral price determination equations than by examining price determination at the aggregate level. Against this advantage of sectoral analysis must be balanced the disadvantage that the sectoral data are on the whole poorer than the aggregate data. As to the type of disaggregation which might best be used in further work in this area two points ought to be given consideration. Firstly, type A disaggregation defines broader sectors and covers a far greater part of the economy. Thus the use of this type of disaggregation has the advantage that data are easier to obtain and that a more complete coverage of the economy is possible.

However, the implicit deflators used are not devised to be used in this type of work. Furthermore, the sectors are not defined with the object of providing sectoral price indexes, whereas this is the case for the type B sectors where the dependent variables may be measured by the components of the CPI and the sectors are defined according to classes of goods which are often more narrow and more homogeneous than the classes of goods covered by the different type A sectors.

Let us now turn to a consideration of questions (3) and (4) posed in Chapter 1.[1] As was mentioned in the previous section when the problem of multicollinearity was discussed, there was some difficulty in obtaining accurate estimates of the lags. Added to the problem of multicollinearity was the limits placed on the experimentation with lags. Given that only one period lags on labour costs were tried, the results are usually fairly clear as to whether current or lagged labour costs are the more important. For the type A sectors there did not appear to be much difference between the results obtained for the various sectors and current labour costs were nearly always more important than lagged labour costs. But the results for the aggregate sector showed the opposite and while the difference between the partial correlation coefficient of the current labour cost variable and the partial correlation coefficient of the lagged labour cost variable (in the preferred equation) is not very large it is nevertheless clear. Hence for the

1. i.e., (3) Do the lag structures found to be most appropriate differ from sector to sector?
(4) Do the lag structures found to be most appropriate for the sectoral equations differ from the lag structure found to be most appropriate for the aggregate equation?

type A sector equations the appropriate lag structure for the labour cost variable is not unambiguously given by the appropriate lag structure for the aggregate case. The same appears to be true for the materials cost variable although in this case the evidence is not as strong since this variable was less often significant.

In the case of the type B sectors there are differences in the appropriate lag structures both between sectors and between the sectoral equations and the aggregate equation. For the type C sectors the appropriate lag structures for the labour cost variables in the sectoral equations show few differences as between the sectors and between the sectoral and the aggregate equations and it appears that the aggregate equations gives a fairly unambiguous indication of the lag structure appropriate for the sectoral equations with the possible exception of the equation for sector C5. In the case of materials costs for type C sectors, it was found that the current materials cost variable was always more important than the variable lagged one or two periods. For the aggregate type C equation, however, the opposite was true and hence again the aggregate equation does not give an unambiguous indication of the appropriate lag structures for the sectoral equations.

Thus, two broad conclusions emerge. Firstly, it would appear that there are sufficient differences (both in the determinants and in the lag structures) in the preferred estimated sectoral equations to warrant further work in the area of sectoral price determination. Secondly, there are sufficient differences between the preferred aggregate equation and the preferred sectoral equations to support the view that it is preferable to explain sectoral prices separately in order to obtain a better understanding of the process of price determination in the Australian economy. Thus the analysis of one price determination equation for the whole economy does not take account of differences between the sectors of the economy and in as far as those differences affect the process of price determination (as was shown in this study by the differences in estimated sectoral price equations) a sectoral approach to the study of price determination produces a more realistic and comprehensive picture of price determination in the economy.

8.4 Suggestions for Further Work

In this section we will briefly collect the various suggestions for further work offered at several points in this chapter. Firstly, it appears from the results obtained in this study that geographical disaggregation is probably the least useful of the three types of disaggregation considered in that there are fewer differences between sectoral equations than in the case of the other types of disaggregation. Further work in this area may not, therefore, be warranted. Consumer-goods disaggregation has the advantage that the least work has been done in this area and that the sectors are more suitably defined for work of this type. It suffers from the disadvantages that only part of the economy is covered and that sectoral data are more difficult to obtain than for final demand sectors.

An important area in which further research is necessary is in relation to productivity data. If more satisfactory short-run productivity data could be constructed it is quite possible that the ULCN variables which were so unsuccessful in this study but successful in most other studies reviewed will be more successful at least for some sectors. Another way in which the ULCN variable could be improved is by trying alternative methods of deriving the series.

A second suggestion for further work offered is to spend more research time on the sectors for which the equations were the least satisfactory (e.g., sectors A2 and A3) in an effort to incorporate any special features of these sectors into the equations.

A third area mentioned previously is to experiment with the first difference form of the equations and to experiment more extensively with lags in order to obtain more conclusive results concerning the lag structures for the various price equations.

BIBLIOGRAPHY

I. BOOKS

Bodkin, R.G., *The Wage-Price-Productivity Nexus,* Philadelphia: University of Pennsylvania Press, 1966.

Bowen, W.G., *The Wage-Price Issue,* Princeton, N.J.: Princeton University Press, 1960.

Duesenberry, J.S.,*et.al., The Brookings Quarterly Econometric Model of the United States,* Chicago: Rand McNally, 1965.

Evans, M.K., *Macroeconomic Activity,* New York: Harper & Row, 1969.

Goldberger, A.S., *Econometric Theory,* New York: Wiley & Sons, 1964.

Hagger, A.J., *The Theory of Inflation: A Review,* Melbourne: Melbourne University Press, 1964.

Hansen, B., *A Study in the Theory of Inflation,* London: Allen & Unwin, 1951.

Johnston, J., *Econometric Methods,* New York: McGraw-Hill, 1963.

Kmenta, J., *Elements of Econometrics,* New York: Macmillan, 1971.

Moulton, H.G., *Can Inflation be Controlled?* Washington: Anderson Kramer Associates, 1958.

Neild, R.R., *Pricing and Employment in the Trade Cycle,* National Institute of Economic and Social Research Occasional Paper No. 21, Cambridge: Cambridge University Press, 1963.

Perry, G.L., *Unemployment, Money Wage Rates and Inflation,* Cambridge, Mass.: M.I.T. Press, 1966.

Pitchford, J.D., *A Study of Cost and Demand Inflation,* Amsterdam: North-Holland, 1963.

Solow, R.M., *Price Expectations and the Behaviour of the Price Level,* Manchester: Manchester University Press, 1969.

Theil, H., *Principles of Econometrics,* Amsterdam: North-Holland, 1971.

II. ARTICLES, PAPERS, etc.

Agarwala, R. and Goodson, G.C., "An Analysis of Consumer Goods Prices in an Input-Output Framework", *Oxford Economic Papers*, 22, March 1970, pp. 57-72.

Almon, S., "The Distributed Lag Between Capital Appropriations and Expenditures", *Econometrica*, 33, January 1965, pp. 178-196.

Bailey, H.J., "Steel and the Post War Rise in the Wholesale Price Index", *Journal of Business*, 35, April 1962, pp. 153-157.

Bowen, W.G. and Masters, S.H., "Shifts in the Composition of Demand and the Inflation Problem", *American Economic Review*, 54, December 1964, pp. 975-984.

Bronfenbrenner, M. and Holzman, F.D., "A Survey of Inflation Theory", *American Economic Review*, 53, September 1963, pp. 593-661.

Brown, A., "Exploring 1970: Some Numerical Results", Chapter 6 in *A Programme for Growth*, Chapman and Hall, 1965.

Eckstein, O. and Fromm, G., "The Price Equation", *American Economic Review*, 58, December 1968, pp. 1159-1183.

________________, "Steel and the Post-War Inflation", Study Paper No. 2 in *Study of Employment, Growth and Price Levels*, Washington: Joint Economic Committee, 1959.

Fisher, F.M., Klein, L.R. and Shinkai, Y., "Price and Output Aggregation in the Brookings Econometric Model", Chapter 17 in *The Brookings Quarterly Econometric Model of the United States*, edited by J.S. Duesenberry *et.al.* Chicago: Rand McNally, 1965.

Godley, W.A.H. and Gillion, C., "Pricing Behaviour in the Engineering Industry", *National Institute Economic Review*, 28, May 1964, pp. 50-52.

________________, "Pricing Behaviour in Manufacturing Industry", *National Institute Economic Review*, 33, August 1965, pp. 43-47.

________ and Rowe, D.A., "Retail and Consumer Prices", *National Institute Economic Review*, 30, November 1964, pp. 44-57.

Goodwin, R.H., "A Note on the Theory of the Inflationary Process", *Economia Internazionale*, 5, January 1952, pp. 1-22.

Gordon, R.A., "Differential Changes in the Prices of Consumers' and Capital Goods", *American Economic Review*, 51, December 1961, pp. 937-957.

Hagger, A.J., "Excess Demand for Labour in Australia, 1948-63", *Economic Record*, 46, March 1970, pp. 26-54.

__________ and Rayner, P.J., "Excess Demand for Commodities in Australia, 1950-51 to 1968-69", *Economic Record*, 49, June 1973, pp. 161-193.

Hansen, A.H., "A Neglected Factor in Inflationary Pressures", *Review of Economics and Statistics*, 61, May 1959, pp. 184-185.

Higgins, C.I., "Short-Run Wage-Price Dynamics, A Quantitative Analysis for Australia", Paper read at the Second Conference of Economists, Sydney, August 1971.

__________, "A Wage-Price Sector for A Quarterly Australian Model", Paper read at the Australasian Conference of Econometricians, Monash, August 1971

__________ and Fitzgerald, V.W., "An Econometric Model of the Australian Economy", *mimeo*, June 1973.

Jacobson, L. and Lindbeck, A., "On the Transmission Mechanism of Wage Change", *Swedish Journal of Economics*, 73, September 1971, pp. 273-293.

Johnson, H.G., "A Survey of Theories of Inflation", *Indian Economic Review*, 6, February 1963, pp. 26-69.

Jorgenson, D.W., "Rational Distributed Lag Functions", *Econometrica*, 32, January 1966, pp. 135-149.

Klein, L.R. and Ball, R.J., "Some Econometrics of the Determination of Absolute Prices and Wages", *Economic Journal*, 69, September 1959, pp. 463-482.

Kuh, E., "Profits, Profit Markups and Productivity: An Examination of Corporate Behaviour since 1947", Study paper No. 15, *Study of Employment, Growth and Price Levels*, Washington: Joint Economic Committee, 1959.

Levinson, H.M., "Postwar Movement of Prices and Wages in Manufacturing Industries", Study Paper No. 21, *Study of Employment, Growth and Price Levels*, Washington: Joint Economic Committee, 1959.

Nieuwenhuysen, J.P. and Norman, N.R., "Wages Policy in Australia: Issues and Tests", *British Journal of Industrial Relations*, 9, November 1971, pp. 353-370.

Norton, W.E. and Henderson, J.F., *A Model of the Australian Economy - A Further Report*, Reserve Bank of Australia, Occasional Paper No. 3G, March 1972.

__________, Schott, K.E. and Sweeny, K.M., *Employment and Prices*, Reserve Bank of Australia Occasional Paper No. 3F, July 1971.

Phipps, A.J., "The Roles of Productivity and Demand in the Pricing Process: An Interindustry Study using Time-Series Data", *Bulletin of the Oxford University Institute of Economics and Statistics*, 1969, pp. 285-301.

Pitchford, J.D., "An Analysis of Price Movements in Australia, 1947-68", *Australian Economic Papers*, 7, December 1968, pp. 111-135.

Preston, E., "Australian Price Changes: Consumer and Capital Goods", *Economic Record*, 43, September 1967, pp. 412-422.

Rushdy, F and Lund, P.J., "The Effect of Demand on Prices in British Manufacturing Industry", *Review of Economic Studies*, 34, 1967, pp. 361-373.

Samuelson, P.A. and Solow, R.M., "Analytical Aspects of Anti-Inflation Policy", *American Economic Review (Papers and Proceedings)*, 1960, pp. 177-194.

Schultze, C.L., "Recent Inflation in the United States", Study Paper No.1, *Study of Employment, Growth and Price Levels*, Washington: Joint Economic Committee, 1959.

__________ and Tryon, J.L., "Prices and Costs in Manufacturing Industries", Study Paper No. 17, *Study of Employment, Growth and Price Levels*, Washington: Joint Economic Committee, 1959.

____________________, "Prices and Wages", Chapter 9 in *The Brookings Quarterly Econometric Model of the United States*, edited by J.S. Duesenberry, *et.al.* Chicago: Rand McNally, 1965.

Simkin, C.G.F., "Inflation in Australia and New Zealand: 1953-71", *Economic Record*, 48, December 1972, pp. 465-482.

Wilson, T.A., "An Analysis of the Inflation in Machinery Prices", Study Paper No. 3, *Study of Employment, Growth and Price Levels*, Washington: Joint Economic Committee, 1959.

Yordon, W.J., "Industrial Concentration and Price Flexibility in Inflation: Price Response Rates in Fourteen Industries, 1947-58", *Review of Economics and Statistics*, 43, August 1961, pp. 287-294.