PRICING BEHAVIOUR
IN AUSTRALIAN MANUFACTURING INDUSTRY
Hypothesis Testing 1955-56 to 1967-68

by

V.B. HALL

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This research was commenced at the University of Sydney, but most of the econometric work was undertaken during a period of Study Leave at the University of Western Ontario.

The author wishes to thank Michael Parkin and Peter Saunders for comments on an earlier draft of this paper, and to acknowledge comments from Russell Boyer and Bob Conlan at a University of Western Ontario Money Workshop. Jim Lamont provided valuable data compilation assistance. The Reserve Bank of Australia's Economic and Financial Research Fund has contributed financial support, but all views remain the responsibility of the author.
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   (ii) Descriptive Evidence
   (iii) Evaluation

II  Research
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   (iii) Time Series Results
      (a) Total Manufacturing Sector
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III  Summary and Conclusions
Pricing Behaviour in Australian Manufacturing Industry

Hypothesis Testing 1955-56 to 1967-68

This paper performs two major tasks. It uses one of the largest sets of consistently classified implicit price deflator data currently available for Australian Manufacturing Industry so as to: (i) test, in both time series and cross section work, a number of well-known alternative price determination hypotheses; and (ii) evaluate the worth of using currently and potentially available implicit price deflator data.

The paper will also consider the progress made to date in Australian Manufacturing Sector price determination research, and so prior to reporting results from this research a brief account is given of previous published work.

I Previous Australian Work

Previous comprehensive quantitative work in this area for Australian Manufacturing Industry is negligible, especially if the nature and quality of work done recently for the United States is taken as a standard. Of such studies as do exist, those most directly relevant are by Whitehead and Hancock. Useful commentary is also obtainable from work by Norton, Schott and Sweeny, Hawkins, Kelly and Lightfoot, and Bentley, Collins and Drane.

There is even very little work of a descriptive nature available, and only contributions by the Tariff Board and the Committee to Advise on Policies for Manufacturing Industry will be referred to.
(1) **Quantitative Evidence**

The pioneering effort is most probably due to Whitehead [24], as in commenting a number of years later, Davidson [3] considered that "Whitehead's article made a heroic attempt to cut through the web of might-be's of which the theory of pricing consists. He made a study of data for 1953-54 to 1957-58 on what he calls the 39 Australian manufacturing industries, a figure which possibly refers to the categories of the ANZ Bank production index...Whitehead's statistics remain an encouraging attempt to test hypotheses with actual data."\(^7\) The quantitative aspects of his study were concerned with the relationship between productivity and implicit deflator price changes, leading him to report the equation

\[
P_c = 171.02 - 0.485 Q \quad \text{s.e.e.} = 12.62 \quad R^2 = 0.703
\]

where

- \(P_c\) = computed percentage index in unit value added
- \(Q\) = computed percentage index in productivity per male unit employed

From this, he concluded that "...approximately 70% of changes in relative prices are associated with differential productivity movements and that a 10% differential increase in labour productivity is associated with a 5% reduction in relative prices,"\(^8\) but the absence of standard errors for both coefficients means there is no indication of the degree of reliability of the influence of productivity. The addition of further explanatory variables might also have altered the coefficients, and so no firm conclusion about the role of productivity can be drawn from the results presented. This uncertainty is clearly in addition to that expressed by Whitehead with respect to the data used, namely that "...the accuracy of the entire exercise depends upon
the accuracy of the production index, and must accordingly be
-treated with reserve, since the empirical and conceptual difficulties associated with the construction of production indices are
well known."

Hancock’s analysis utilised industry data for a longer
time period (i.e., 1949-50 to 1967-68) than did Whitehead’s, and
he chose as his principal terms of reference the examination of
a simple long-period aggregate relationship between the log linear
trends of changes in cross section implicit deflator unit prices
($\ln \hat{P}_i$), the sum of labour, material, and capital input costs
per unit of labour employed ($\ln \hat{C}_i$), and labour productivity
($\ln \hat{X}_i$) i.e.,

$$\ln \hat{P}_i = \alpha + \beta_1 \ln \hat{C}_i + \beta_2 \ln \hat{X}_i$$

If the hypothesis that $\alpha = 0$, $\beta_1 = 1$, and $\beta_2 = -1$ were each
unable to be rejected, it was considered that any one of three
alternative long-run hypotheses might be consistent with the data,
i.e., a competitive model, a Chamberlinian monopolistic competition
pure profits competed away model, or a full-cost model. On the
other hand, if $\beta_1 < 1$ and $\beta_2 > -1$, then it was assumed oligopolis-
tic "stickiness" in prices might be the hypotheses consistent
with the data. It was stated at the outset of the analysis
that pressure of demand influences would/could not be tested,
nor would differences in industrial concentration be considered;
and clearly the terms of reference of the analysis precluded
attention being given to the question of short-run versus long-
run hypotheses.

With respect to Hancock’s principal results, it was con-
cluded that the hypotheses that $\beta_1 = 1$ and $\beta_2 = -1$ could each
not be rejected, and therefore that changes in relative prices
were directly proportional to changes in unit input costs
(which must include capital costs). The relationship or mark-up was held not necessarily to be stable over time, though. As tests on the hypothesis that \( \alpha = 0 \) were inconclusive, then it was held that price changes need not necessarily be determined by unit costs alone, and could further perhaps be affected by "... macroeconomic forces such as an average rise in costs, a general pressure of demand or widely held inflationary expectations." 

Although not stated explicitly by Hancock, it can perhaps further be pointed out that his oligopolistic price stickiness model cannot be accepted, and that while none of the three competitive, monopolistic, and full-cost models were rejected no attempt was made to formulate a more restrictive set of hypotheses which would perhaps enable differentiation between the three models.

From the Whitehead and Hancock studies, therefore, we know little more than that some satisfactory aggregate level correlations have been achieved.

Turning to the other three studies mentioned above, it is first noted that the work of Norton, Schott and Sweeny [15] and of Hawkins, Kelly and Lightfoot [12] was conducted at a degree of aggregation different from and higher than that for this study. The former is relevant here, however, in giving us summary opinion (from the analysis of seven different price deflator variables) that as "...normal ULCs [unit labour costs] perform better than ULCs... , ... oligopolistic influences dominate competitive influences in price determination",\(^\text{13}\); while the latter (on the basis of attempting to explain three different price deflators) consider "...the relative performance of the measures of ULCs and normal ULCs suggests there is a mix of competitive and oligopolistic pricing. Oligopolistic influences appear to be dominant in the case of durables, whereas competitive influences seem to be
relatively more important for non-durables." It can also be mentioned that Hawkins, Kelly and Lightfoot seemed well aware of some of the major data problems in the pricing area, and as a result decided against further disaggregated work because "The shortage of data appropriate to disaggregated price equations is unlikely to be alleviated in the near future." Bentley, Collins, and Drane [1] favoured a mark-up hypothesis for the purposes of their work, as for firms selling durable goods "...in our opinion firms generally do not maximise profits but use a form of mark-up pricing." 

(ii) Descriptive or Non-quantitative Evidence

As could be expected once it was known the approach they had chosen for themselves, the Committee to Advise on Policies for Manufacturing Industry [2] made little reference to pricing in Manufacturing Industry or to price determining behaviour. Principal information from their Report of relevance to this study would be their comments relating to the 1950s and 1960s that "This was a period of almost continuous strong growth in manufacturing...........full employment and stable prices were sustained over most of this period. Foreign investment was actively encouraged by all governments.....It was not until the 1960s that the tariff again became the dominant instrument of protection", and that "The growth industries of this period were plastics, chemicals, oil refining, motor vehicles and parts, machinery, metal manufactures, pulp and paper...the technology intensive industries--chemicals, plastics, and optical and scientific instruments".

Like the Report of the Committee to Advise on Policies for Manufacturing Industry, the 1971 Annual Report of the Tariff Board was more concerned with issues other than pricing, and so
on an initial reading little information stands out on prices. Nevertheless, there is a little worthwhile pricing information there, and it will provide (together with Hancock's work and conclusions) a reference point for the econometric work reported in Section 2 of this study. As has previously been reported implicit price deflators (of the value-added type) are presented for 31 Industries and the Total Manufacturing Sector in Index Form (Base 1959-60 = 100) for the 13 years 1955-56 to 1967-68. Additionally, with respect to the relative rates of growth of the various series and to their simple correlations of the implicit price deflator series with series for other variables,

(a) their annual average rate of growth in percentage terms are presented in Table 4 on p. 15, and two principal conclusions are that for Total Manufacturing "The implicit price index...remained stable between 1956-57 and 1963-64 but increased steadily during the four years to 1967-68" and for the Industries Chemicals and Fertilisers, Plastic Products, Optical and Scientific Instruments, and Motor Vehicles and Parts, "Implicit prices for the four industries declined." 

(b) simple Spearman or Pearson cross sectional correlations are presented in Table 9, Appendix 2, p. 50, and while it was concluded that "The rate of increase in implicit prices tended to be higher in the less labour intensive industries and in the industries with above average nominal protection available," the latter relationship was not significant at the 5% level, and nor were relationships involving effective protection, sales
concentration, foreign control, and capital/persons employed.

(i:i) Evaluation

It is suggested that the previously available Australian quantitative or econometric evidence tells us little more than that

(a) price determination hypotheses have been either imposed without testing of alternatives, or tested insufficiently rigorously when alternatives have been postulated,²⁵

(b) there is a directly proportional long-term average relationship for average manufacturing industry between its implicit price deflator and unit input costs and labour productivity. This relationship need not necessarily provide a complete explanation,²⁶ it fails to distinguish amongst a number of alternative competing price determination hypotheses, and does not seem to have been tested industry by industry for divergence from the industry average,

(c) the work done and results achieved are likely to be heavily conditioned by the quantity and quality of data available.²⁷

The non-econometric or descriptive evidence adds very little further than this to our understanding, other than that

(a) there is a reasonable dispersion of relative implicit price deflator movements by industry,

(b) relative implicit price deflator movements may vary according to the degree of labour intensity of the industry,
(c) relative implicit prices are unlikely to vary significantly with the degree of sales concentration or foreign control or with the capital/output ratio,

(d) the issue is confused or unresolved with respect to tariff protection.

II Research

(i) Data

In footnote 2 it was pointed out that the consistent data classification used is that of the Tariff Board rather than of the Commonwealth Statistician. It deals with the Manufacturing Sector, Industries, and their sub-divisions, but not individual firms.

The time series sample consists of a maximum of thirteen annual observations for the period 1955-56 to 1967-68 in Index form with base 1959-60 = 100.

A complete cross section sample for the Total Manufacturing Sector would cover thirteen major industries containing in total 31 industry sub-divisions. In both the time series econometric work for individual industries and the cross section econometric work, though, data for only 23 of these subdivision were used, as the implicit price deflator series for some eight sub-divisions were considered unlikely to be sufficiently reliable.²⁸

With respect to the specific implicit price deflator series to be explained, it has previously been pointed out²⁹ that hypotheses would be formulated and tested for both the value of final output or exfactory selling value (P) and net value added (PVA) deflators. Tables 1 and 2 indicate the extent to which movements in the P and PVA series are different, by presenting both over time and according to industry.³⁰ the arithmetic mean and degree
TABLE 1
Arithmetic Means and Standard Deviations of Average Annual Implicit Price Deflator Percentage Changes

1956-57 to 1967-68 for 31 Industry Sub-Divisions

<table>
<thead>
<tr>
<th>Year</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Mean</th>
<th>Standard Deviation</th>
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</thead>
<tbody>
<tr>
<td>1956-57</td>
<td>3.71</td>
<td>3.78</td>
<td>4.61</td>
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<tr>
<td>1957-58</td>
<td>0.14</td>
<td>6.01</td>
<td>0.31</td>
<td>6.33</td>
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<tr>
<td>1958-59</td>
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<td>4.96</td>
<td>0.46</td>
<td>5.46</td>
</tr>
<tr>
<td>1959-60</td>
<td>2.37</td>
<td>5.27</td>
<td>2.44</td>
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<td>1960-61</td>
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<td>2.48</td>
<td>1.32</td>
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</tr>
<tr>
<td>1961-62</td>
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<tr>
<td>1966-67</td>
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<td>2.84</td>
<td>3.92</td>
<td>3.68</td>
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<tr>
<td>1967-68</td>
<td>1.07</td>
<td>3.55</td>
<td>2.71</td>
<td>4.82</td>
</tr>
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</table>
# TABLE 2

**Arithmetic Means and Standard Deviations of Average Annual Implicit Price Deflator Percentage Changes for 31 Industry Sub-Divisions During 1956-57 to 1967-68**

<table>
<thead>
<tr>
<th>Industry</th>
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<th>Mean</th>
<th>Standard Deviation</th>
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<td>4.08</td>
<td>3.25</td>
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<td>1.69</td>
<td>1.89</td>
<td>2.02</td>
<td>2.04</td>
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<td>7.37</td>
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<td>3.52</td>
<td>6.12</td>
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<tr>
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<td>1.96</td>
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<td>1.89</td>
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<td>2.49</td>
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<td>5.81</td>
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<td>0.40</td>
<td>1.67</td>
<td>1.08</td>
<td>1.94</td>
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<tr>
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<td>3.45</td>
<td>-0.44</td>
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<td>6.52</td>
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<td>7.4</td>
<td>1.55</td>
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<td>2.97</td>
<td>2.85</td>
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<td>2.74</td>
<td>0.68</td>
<td>4.08</td>
</tr>
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</table>
of dispersion of the percentage changes in the annual average values of the two sets of series.

The remaining variables and data and the full Tariff Board Classification are described and attached in the Appendix.

(ii) Hypotheses

Recent empirical testing of price determination hypotheses has not been noted for the strength of its theoretical foundation, for its success in differentiating alternative theories or hypotheses, nor for the rigour of the econometric work. In fact, the current situation is well summed up in a recent article by Popkin who considers "...the present research...effort [in the testing of hypotheses]...encounters the common difficulties in so doing - the lack of precise specification of any but the most simplistic models, poor or missing data, and estimation problems. To preview a conclusion, price behaviour is difficult to explain and no one theory can be shown to be superior to all others."

Particular areas of confusion seem to be the result of failure to distinguish properly between short-run and long-run hypotheses, failure to differentiate or characterise properly "competitive" and "less-competitive or oligopolistic-type" hypotheses, and consistent omission of capital costs variables.

This work tackles each of these and other issues in as rigorous a manner as is practically possible. On the long-run versus short-run question, it is assumed that long-run hypotheses should incorporate normalised or standard levels of production and costs and should include a specific capital costs variable. With respect to the "competitive" and "less-competitive" industries question, no single test would seem
satisfactory - reference will therefore be had to such factors as the type of hypothesis set up, the significance of an explicit excess demand influence, and the significance of such factors as degree of sales concentration, degree of tariff protection, financial performance, and degree of foreign ownership or overseas control. Testing for any explicit excess demand influence is far from satisfactory - such usual measures as inventory deviations from planned or optimal levels, changes in unfilled order levels, and various labour market variables were not available, and only a capacity utilisation variable of crude variety (i.e., the deviation of actual from trend or normal output) could therefore be used. It has not been possible to take into account specifically any external influences. 34

Hypotheses are tested under the headings of (a) "classical" model, (b) "neo-classical" model, (c) "target-return" model, (d) "full-cost" model, and (e) "modified mark-up" or "mixed" model hypotheses, each of which is now briefly outlined.

(a)  "Classical" Model Hypotheses

The "classical" model hypothesis tested here derives out of that of Eckstein and Fromm [6]. Their theory is based on what they term the supply-demand, competitive mechanism and takes specific account of the determinants of changes in supply and demand curves, any order and inventory disequilibrium influences in the goods market, and the industry operating rate (or level of capacity utilisation). 36

\[ \Delta \text{price} = f(\Delta \text{unit labour costs, } \Delta \text{unit material costs, order disequilibrium, inventory disequilibrium, industry operating rate}) \]
As data are not available on order and inventory disequilibrium, our hypothesis is set up with only the industry operating rate as an explicit excess demand influence. Unit capital costs do not appear in this essentially short-run hypothesis of Eckstein and Fromm, and according to Nordhaus [13, p. 40], this omission is legitimate for some but not all versions of the classical theory. Our "classical" hypothesis is set up and tested both with and without including unit capital costs, and the influence of capital may of course additionally be reflected through the capacity utilisation variable.

The two forms of our short-run hypothesis are thus

\[
\begin{align*}
\Delta \ln P &= \alpha_0 + \alpha_1 \Delta \ln ULC + \alpha_2 \Delta \ln UMC + \alpha_3 \ln CU \\
\Delta \ln P &= \alpha_0' + \alpha_1' \Delta \ln ULC + \alpha_2' \Delta \ln UMC + \alpha_3' \ln CU + \alpha_4' \Delta \ln UKC
\end{align*}
\]

where
\[
\Delta = \text{first difference change},
\]

\(\Delta \ln P\) = change in log of implicit ex-factory selling price deflator (i.e. \(\ln P - \ln P_{-1}\)),

\(\Delta \ln ULC\) = change in log of unit labour costs,

\(\Delta \ln UMC\) = change in log of unit materials costs,

\(\ln CU\) = log of level of capacity utilisation,

\(\Delta \ln UKC\) = change in log of unit capital costs,

and they enable us to test (on the basis of simple tests of significance on the coefficients \(\alpha_3\), \(\alpha_3'\), and \(\alpha_4'\)) whether explicit excess demand and/or capital cost influences have been influential in affecting implicit price deflator changes.

(b) "Neo-classical" Model Hypotheses

Of the five basic classes of hypothesis we set up, those in the "neo-classical" class can probably vary most in accordance with assumptions made. The form of the production function
(e.g., the number of factors, the degree of returns to scale, the type of technological progress) and the type of demand and other constraints in the optimisation problem chosen to be set up can all influence the form of the resulting price equation to be estimated, and the degree of sophistication of the econometric estimation method used can further affect the resulting structural parameter values.

"Neo-classical" models are also essentially factor price rather than unit cost models and usually refer to price levels rather than price changes, and so need not necessarily be directly comparable with other major classes of hypothesis.

Further problems faced in this research in attempting to test thoroughly any "neo-classical" hypotheses are that it has been necessary to proxy materials price by materials input value per unit of real output and capital services price by capital input value per unit of real output. It is also not practical to impose all parameter restrictions required by economic theory, due to the small number of time series observations (and hence even more limited number of degrees of freedom).

Hence, the hypotheses we set up are almost the simplest possible, i.e., for a Cobb-Douglas constant returns-to-scale production function. The short-run models are set up in both unrestricted and constant returns-to-scale restricted form. Each of these forms then further make either no specific explicit allowance for productivity (but thereby implying productivity is smoothly growing) or allow through the time trend for Hicks-neutral technological change to capture productivity, i.e.,
(3) \[ \ln P = \alpha_0 + \alpha_1 \ln(W/L) + \alpha_2 \ln(M/Y) \]

\[(3') (\ln P - \ln(M/Y)) = \alpha_0' + \alpha_1' (\ln(W/L) - \ln(M/Y)) \]

(4) \[ \ln P = \beta_0 + \beta_1 \ln(W/L) + \beta_2 \ln(M/Y) - \beta_3 t \]

\[(4') (\ln P - \ln(M/Y)) = \beta_0' + \beta_1' (\ln(W/L) - \ln(M/Y)) - \beta_3' t \]

where

\[ \ln W = \log \text{of total wages and salaries}, \]

\[ \ln L = \log \text{of total employment}, \]

\[ \ln M = \log \text{of value of materials}, \]

\[ \ln Y = \log \text{of volume of production}, \]

\[ t = \text{time trend}. \]

The longer run models are similar in concept, but additionally allow for trend production, \( Y_N \), rather than actual production, \( Y \), and incorporate capital costs, i.e.,

(5) \[ \ln P = \gamma_0 + \gamma_1 \ln(W/L) + \gamma_2 \ln(M/YN) + \gamma_3 \ln(D/YN) \]

\[(5') (\ln P - \ln(M/YN)) = \gamma_0' + \gamma_1' (\ln(W/L) - \ln(M/YN)) + \gamma_3' (\ln(D/YN) - \ln(M/YN)) \]

(6) \[ \ln P = \delta_0 + \delta_1 \ln(W/L) + \delta_2 \ln(M/YN) + \delta_3 \ln(D/YN) - \delta_4 t \]

\[(6') (\ln P - \ln(M/YN)) = \delta_0' + \delta_1' (\ln(W/L) - \ln(M/YN)) + \delta_3' (\ln(D/YN) - \ln(M/YN)) - \delta_4' t \]

where

\[ \ln D = \log \text{of capital costs} \]

\[ \ln Y_N = \log \text{of trend volume of production}. \]

Clearly, as a minimum, the constant returns to scale restrictions imposed in (3'), (4'), (5') and (6') can be tested, and such additional tests on the values of the input elasticities as outlined in Nordhaus [13, pp. 28-29] should also be conducted if possible.
(c) "Target-return" Model Hypotheses

The "target-return" model, applicable to longer run price setting and also generally seen as most relevant to the more oligopolistic-type industries, is postulated in Eckstein [5] and in Eckstein and Fromm [6, p. 1165] as

\[ P = \left( \hat{\Pi} \right) / YN + ULCN + UMCN \]

where

\[ \hat{\Pi} = \text{target rate of return on capital at a standard volume of real output}, \]

\[ K = \text{level of real capital stock}, \]

\[ ULCN = \text{level of standard unit labour costs}, \]

\[ UMCN = \text{level of standard unit material costs}. \]

The relevant hypotheses have been set up for estimation and testing either in the form \(^4\)

\[ (7) \ P = \alpha_0 + \alpha_1 (K/YN) + \alpha_2 ULCN + \alpha_3 UMCN \]

(where \( \alpha_0 = 0, \alpha_2 = 1, \) and \( \alpha_3 = 1 \) are requirements for the hypothesis not to be rejected, and \( \alpha_1 \) provides an estimate of the industry target rate of return, \( \hat{\Pi} \), or in the form \(^4\)

\[ (8) \ \Delta P = \beta_0 + \beta_1 \Delta (K/YN) + \beta_4 \Delta \hat{\Pi} + \beta_2 \Delta ULCN + \beta_3 \Delta UMCN \]

(where \( \beta_0 = 0, \beta_2 = 1, \) and \( \beta_3 = 1 \) are requirements again for the hypothesis not to be rejected, and \( \beta_4 \) and \( \beta_1 \) provide estimates of the mean industry capital/normal output ratio and target rate of return, respectively).

Additionally, if it becomes established that the target rate of return hypothesis cannot be rejected, then the "optimal pricing" test suggested by Nordhaus [13, p. 29] can further be conducted.
The unrestricted and restricted forms of equation (7) tested were

\[ (9) \quad \ln P = \alpha_0 + \alpha_1 \ln(K/YN) + \alpha_2 \lnULCN + \alpha_3 \lnUMCN \]

\[ (9') \quad (\ln P - \lnULCN - \lnUMCN) = \alpha_0' + \alpha_1' \ln(K/YN). \]

where

\[ \ln K = \text{log of real depreciated capital stock} \]
\[ \lnULCN = \text{log of normal unit labour costs} \]
\[ \lnUMCN = \text{log of normal unit materials costs}. \]

The forms of equation (8) tested acknowledge that there are no data series for \( \hat{\Pi} \), assume that there is a constant target rate of return (i.e. \( \Delta \hat{\Pi} = 0 \)), and attempt to obtain an estimate of \( \hat{\Pi} \) from

\[ (10) \quad \Delta \ln P = \beta_0 + \beta_1 \Delta \ln(K/YN) + \beta_2 \Delta \lnULCN + \beta_3 \Delta \lnUMCN \]

\[ (10') \quad (\Delta \ln P - \Delta \lnULCN - \Delta \lnUMCN) = \beta_0' + \beta_1' \Delta \ln(K/YN) \]

These "target-return" hypotheses will not be tested for the FVA series, as they would seem to demand materials costs as an explanatory variable. Should significant values be obtained for \( \hat{\Pi} \) from the coefficients \( \alpha_1, \alpha_1', \beta_1, \) and \( \beta_1' \), it might also be worthwhile to compare these individual industry estimates with the "rule of thumb" capital input cost values of .15 and .25 imposed by Hancock [11] across all industries.

(d) "Full-cost" Model Hypotheses

The "full-cost" model, being a variant of the "target-return" model, is also based on the Eckstein [5] or Eckstein and Fromm [6] formulation. This makes it, too, essentially a longer run oligopolistic type model, and it has also been set up and estimated from either of the two forms

\[ (11) \quad P = (1 + \lambda)(ULCN + UMCN) \]
(12) \( \Delta P = (1 + \lambda)\Delta(ULCN + UMCN) + (ULCN + UMCN)\Delta(1 + \lambda) \)

where

\[ \lambda = \text{"full-cost" markup coefficient.} \]

As represented in equations (11) and (12), the markup is set to cover the cost of capital services, indirect costs, and profit. In practice, though, some firms will markup not just on labour and material costs but on capital costs as well, and so this form of "mark-up" hypothesis will also be tested.\(^{44}\)

Clearly, a primary aim of this set of hypotheses is to obtain a satisfactory estimate for \( \lambda \). We test for a constant markup in

(13) \( \ln P = \alpha_0 + \alpha_1 (\ln ULCN + \ln UMCN) , \)

(14) \( \ln P = \alpha_0' + \alpha_1' (\ln ULCN + \ln UMCN + \ln UKCN) , \)

where \( \lambda_1 = \alpha_1 - 1 \), and \( \lambda_2 = \alpha_1' - 1 \). For a markup which varies with excess demand (e.g. \( \lambda = \theta \ln CU \)), the equations tested are

(15) \[ \ln P - (\ln ULCN + \ln UMCN) = \beta_0 + \beta_1 [(\ln CU)(\ln ULCN + \ln UMCN)] , \]

(16) \[ \ln P - (\ln ULCN + \ln UMCN + \ln UKCN) = \beta_0' + \beta_1' [(\ln CU)(\ln ULCN + \ln UMCN + \ln UKCN)] , \]

where \( \theta_1 = \beta_1 > 0, \theta_2 = \beta_1' > 0 \).

The hypotheses in change form corresponding with equations (13) to (16) are straightforward and need not be spelt out. Bear in mind though that the term \( \Delta(1 + \lambda) \) in equation (12) disappears if the markup is assumed constant.

(e) "Modified Markup" or "Mixed" Model Hypotheses

The "modified markup" model was formulated as a three part hypothesis by Schultze and Tryon \([20]\) as follows\(^{45}\)
\[ P = f[ULCN, (ULC-ULCN), UMC, UNCN, \]

positive deviations from normal industrial operating rate,
negative deviations from normal industrial operating rate,
positive deviations from normal sales,
negative deviations from normal sales,

deviations from trend/inventory output ratio.\]

Such a model was also recommended by Nordhaus [13, p. 35], except for its lack of specific recognition of capital costs. Our data base does not enable us to test the significance of the latter two excess demand influences, but the influence of capacity utilisation deviations can be tested both with and without allowing for asymmetrical positive and negative effects. We further postulate a shorter-run (i.e., not pure short run as trend output and normal costs are allowed for) Schultze and Tryon type model and a long-run Nordhaus type model, neither of which incorporates both UMC and UNCN variables due to their probable collinearity.

Hence, our "modified markup" hypotheses\(^46\) are

\[ \ln P = \alpha_0 + \alpha_1 \ln ULCN + \alpha_2 (\ln ULC - \ln ULCN) + \alpha_3 \ln UMC + \alpha_4 \ln CU \]

\[ \ln P = \alpha_0 + \alpha_1 \ln ULCN + \alpha_2 (\ln ULC - \ln ULCN) + \alpha_3 \ln UMC + \alpha_4 (+) \ln CU + \alpha_4 (-) \ln CU \]

\[ \ln P = \beta_0 + \beta_1 \ln ULCN + \beta_2 (\ln ULC - \ln ULCN) + \beta_3 \ln UMCN + \beta_4 \ln UKCN + \beta_5 \ln CU \]

\[ \ln P = \beta_0 + \beta_1 \ln ULCN + \beta_2 (\ln ULC - \ln ULCN) + \beta_3 \ln UMCN + \beta_4 \ln UKCN + \beta_5 (+) \ln CU + \beta_5 (-) \ln CU \]

where \( (+) \ln CU = \) positive values of \( \ln CU \) (i.e. \( \ln Y - \ln YN \)),

\( (-) \ln CU = \) negative values of \( \ln CU \),

and with all coefficients required to be positive, the coefficient of \( \ln ULCN \) to be greater than the coefficient of \( (\ln ULC - \ln ULCN) \),

and the coefficients \( \alpha_4 \) and \( \beta_5 \) to be significantly different from
α₄" and β₅" for asymmetry to exist.

The change variable forms of the "modified markup"
hypotheses (17) to (20) can be presented as forms of the "mixed"
model hypothesis of Eckstein and Fromm [6], "mixed" being in the
sense of combining "classical" and "full-cost" model influences.
The original Eckstein and Fromm version is

\[ ΔP = f[ΔULCN, Δ(ULC-ULCN), ΔUMC, Industry operating rate, 
      Inventory disequilibrium.] \]

Our shorter- and long-run versions, with and without allowing for
classical excess demand influences, are

(21) \[ ΔlnP = γ₀ + γ₁ΔlnULCN + γ₂Δ(lnULC-lnULCN) + γ₃ΔlnUMC + γ₄lnCU \]

(22) \[ ΔlnP = γ₀' + γ₁'ΔlnULCN + γ₂'Δ(lnULC-lnULCN) + γ₃'ΔlnUMC 
        + γ₄'(+)lnCU + γ₄''(-)lnCU \]

(23) \[ ΔlnP = δ₀ + δ₁ΔlnULCN + δ₂Δ(lnULC-lnULCN) + δ₃ΔlnUMCN 
        + δ₄ΔlnUKCN + δ₅lnCU \]

(24) \[ ΔlnP = δ₀' + δ₁'ΔlnULCN + δ₂'Δ(lnULC-lnULCN) + δ₃'ΔlnUMCN 
        + δ₄'ΔlnUKCN + δ₅'(+)lnCU + δ₅''(-)lnCU \]

in which, as for equations (17) to (20), it is required that all
coefficients be positive, the coefficient on ΔlnULCN be greater
than the relevant coefficient on Δ(lnULC-lnULCN), and the coefficient
on (+)lnCU be significantly different from that on (-)lnCU.

Additional tests can be conducted because of the "mixed" or
three-part nature of the above hypotheses. Firstly, with respect
to testing for the significance of an explicit excess demand
influence in (21) versus that in the "classical" hypothesis (1):
for the two equations to give equivalent results (i.e. for there
to be no ULCN influence), it is necessary that γ₁ = γ₂ and γ₂ = α₁,
γ₃ = α₂, and γ₄ = α₃; and for the two equations to be not
inconsistent and yet allow differential influences from ΔlnULC.
and $\Delta \ln ULCN$, then it is required that $\gamma_1 > \gamma_2$ and $\gamma_2 = \alpha_1$, $\gamma_3 = \alpha_2$, and $\gamma_4 = \alpha_3$. Secondly, equivalence of the "mixed" model hypothesis (23) with the change form of the "full-cost" hypothesis (14) would require $\delta_2 = 0$, $\delta_5 = 0$, $\delta_0 = \sigma_0^\prime$, and $\delta_1 = \delta_3 = \delta_4 = \alpha_1^\prime$.

(iii) **Time Series Results**

(a) **Total Manufacturing Sector**

"Classical" Model

Neither of the "classical" model hypotheses (1) nor (2) could be accepted for the sample data, as no excess demand nor short-run capital cost variable provided a significantly greater explanation than an equation incorporating simply short-run labour and material costs. This was the case for both ex-factory selling value and net value added price deflators as dependent variables.

"Neo-classical" Model

None of the longer run model hypotheses (5) and (6') could be accepted, due to negative coefficients on the materials and capital costs variables in the unrestricted forms, and due to at least one negative elasticity in each of the restricted forms.

With the short-run model hypotheses (3) to (4'), although the coefficient of the time trend variable is of correct negative sign no significantly greater explanation is provided by its inclusion. The constant returns to scale restrictions imposed in equation (3') could not be accepted either, so the overall conclusion is that this form of short-run "neo-classical" model could not be accepted.

The simple equation (3), incorporating the wage rate per person employed and short-run unit material costs, and implying
### Table 3

**OLS Results for Total Manufacturing Sector**

<table>
<thead>
<tr>
<th>&quot;Classical&quot; Model Results - Dependent Variable ΔlnP</th>
<th>$\hat{R}^2$</th>
<th>SEE</th>
<th>RSS</th>
<th>D-W</th>
<th>ρ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equation (1)</td>
<td>.004</td>
<td>.170</td>
<td>.920</td>
<td>.052</td>
<td>.893</td>
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<tr>
<td></td>
<td>[.37]</td>
<td>[1.1]</td>
<td>[3.2]</td>
<td>[1.5]</td>
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</tr>
<tr>
<td>Equation (2)</td>
<td>.001</td>
<td>.297</td>
<td>1.01</td>
<td>.053</td>
<td>-.105</td>
</tr>
<tr>
<td></td>
<td>[.3]</td>
<td>[1.3]</td>
<td>[4.7]</td>
<td>[1.0]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>.003</td>
<td>.193</td>
<td>1.05</td>
<td>.030</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[1.3]</td>
<td>[2.3]</td>
<td>[5.7]</td>
<td>[1.1]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>.004</td>
<td>.205</td>
<td>1.02</td>
<td>.042</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[3.2]</td>
<td>[2.4]</td>
<td>[5.3]</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>&quot;Neo-classical&quot; Model Results - Dependent Variable lnP</th>
<th>ln(N/Y) or ln(W/L) ln(N/YH) ln(D/YH) t</th>
<th>$\hat{R}^2$</th>
<th>SEE</th>
<th>RSS</th>
<th>D-W</th>
<th>ρ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equation (3)</td>
<td>-1.13</td>
<td>.994</td>
<td>1.15</td>
<td>.303</td>
<td>.970</td>
<td>.0042</td>
</tr>
<tr>
<td></td>
<td>[2.1]</td>
<td>[8.7]</td>
<td>[9.6]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equation (4')</td>
<td>-.0007</td>
<td>.096</td>
<td>0.94</td>
<td>-.005</td>
<td>.919</td>
<td>.0058</td>
</tr>
<tr>
<td></td>
<td>[-.7]</td>
<td>[8.5]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equation (4)</td>
<td>-1.010</td>
<td>.221</td>
<td>1.00</td>
<td>-.3053</td>
<td>.973</td>
<td>.0045</td>
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<tr>
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<td>[1.9]</td>
<td>[2.2]</td>
<td>[6.7]</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Equation (6')</td>
<td>.028</td>
<td>.221</td>
<td>1.00</td>
<td>-.0053</td>
<td>.934</td>
<td>.0051</td>
</tr>
<tr>
<td></td>
<td>[1.0]</td>
<td>[1.9]</td>
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<td></td>
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<tr>
<td>Equation (5)</td>
<td>3.11</td>
<td>.326</td>
<td>-.112</td>
<td>-.183</td>
<td>.805</td>
<td>.0120</td>
</tr>
<tr>
<td></td>
<td>[6.6]</td>
<td>[3.2]</td>
<td>[6.6]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equation (5')</td>
<td>4.79</td>
<td>-.042</td>
<td>1.092</td>
<td>.133</td>
<td>.473</td>
<td>.0246</td>
</tr>
<tr>
<td></td>
<td>[6.6]</td>
<td>[3.2]</td>
<td>[1.0]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equation (6)</td>
<td>1.52</td>
<td>.696</td>
<td>-.150</td>
<td>-.0082</td>
<td>.858</td>
<td>.0109</td>
</tr>
<tr>
<td></td>
<td>[1.5]</td>
<td>[3.0]</td>
<td>[1.9]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equation (6')</td>
<td>.347</td>
<td>.973</td>
<td>-.030</td>
<td>.057</td>
<td>.883</td>
<td>.0122</td>
</tr>
<tr>
<td></td>
<td>[4.9]</td>
<td>[4.9]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

[ ] = "t" ratio  
$\hat{R}^2$ = coefficient of determination  
SEE = equation standard error of estimate  
* = cannot accept hypothesis of first-order serial correlation at 5% level of significance  
RSS = residual sum of squares  
D-W = Durbin-Watson statistic  
ρ = First order Autocorrelation coefficient  
** = Durbin-Watson test inconclusive
### TABLE 3 (continued)

**OLS RESULTS FOR TOTAL MANUFACTURING SECTOR**

#### "Target-return" Model Results

<table>
<thead>
<tr>
<th>Equation</th>
<th>Coefficients</th>
<th>$R^2$</th>
<th>SEE</th>
<th>RSS</th>
<th>D-W</th>
<th>$c$</th>
</tr>
</thead>
<tbody>
<tr>
<td>(9) $\ln P = 4.60 + .107 \ln(K/YN) + .680 \ln ULCN - .407 \ln UMCN$</td>
<td>[.879] [.30] [2.8] [1.4]</td>
<td>.718</td>
<td>.0145</td>
<td>.00188</td>
<td>1.34**</td>
<td></td>
</tr>
<tr>
<td>(9') $(\ln P - \ln ULCN - \ln UMCN) = 4.59 + .167 \ln(K/YN)$</td>
<td>[2.61] [1.4]</td>
<td>.151</td>
<td>.0506</td>
<td>.02814</td>
<td>1.41*</td>
<td></td>
</tr>
<tr>
<td>(10) $\Delta \ln P = .016 - .347 \Delta \ln(K/YN) + .382 \Delta \ln ULCN - .409 \Delta \ln UMCN$</td>
<td>[2.7] [2.0] [1.8] [1.9]</td>
<td>.543</td>
<td>.0121</td>
<td>.00117</td>
<td>1.41**</td>
<td></td>
</tr>
<tr>
<td>(10') $(\Delta \ln P - \Delta \ln ULCN - \Delta \ln UMCN) = -.021 + 1.037 \Delta \ln(K/YN)$</td>
<td>[.8] [.5]</td>
<td>.175</td>
<td>.0587</td>
<td>.03442</td>
<td>2.04*</td>
<td></td>
</tr>
</tbody>
</table>

#### "Full-cost" Model Results

<table>
<thead>
<tr>
<th>Equation</th>
<th>Coefficients</th>
<th>$R^2$</th>
<th>SEE</th>
<th>RSS</th>
<th>D-W</th>
<th>$c$</th>
</tr>
</thead>
<tbody>
<tr>
<td>(13) $\ln P = 4.71 + .092 (\ln ULCN + \ln UMCN)$</td>
<td>[.57] [.17]</td>
<td>.782</td>
<td>.0113</td>
<td>.00115</td>
<td>.86</td>
<td>.96 [11.9]</td>
</tr>
<tr>
<td>(14) $\ln P = 4.58 + .153 (\ln ULCN + \ln UMCN + \ln UKCN)$</td>
<td>[642] [4.9]</td>
<td>.870</td>
<td>.0087</td>
<td>.00069</td>
<td>1.21**</td>
<td>55 [2.2]</td>
</tr>
<tr>
<td>(15) $(\ln P - (\ln ULCN + \ln UMCN)) = 4.62 - .773 [(\ln CU) (\ln ULCN + \ln UMCN)]$</td>
<td>[793] [7.7]</td>
<td>.869</td>
<td>.0191</td>
<td>.00327</td>
<td>.72</td>
<td></td>
</tr>
<tr>
<td>(16) $(\ln P - (\ln ULCN + \ln UMCN)) = 4.59 - .882 [(\ln CU) (\ln ULCN + \ln UMCN + \ln UKCN)]$</td>
<td>[.799] [.41]</td>
<td>.993</td>
<td>.0123</td>
<td>.00136</td>
<td>56</td>
<td></td>
</tr>
</tbody>
</table>

#### "Modified Mark-up" Model Results

<table>
<thead>
<tr>
<th>Equation</th>
<th>Coefficients</th>
<th>$R^2$</th>
<th>SEE</th>
<th>RSS</th>
<th>D-W</th>
<th>$c$</th>
</tr>
</thead>
<tbody>
<tr>
<td>(17) $\ln C = -1.92 + .254 \ln ULCN + .18 \ln UMCN or \ln UMCN$</td>
<td>[.15] [.17] [1.8]</td>
<td>.977</td>
<td>.0045</td>
<td>.00012</td>
<td>3.07**</td>
<td>.72 [3.4]</td>
</tr>
<tr>
<td>(18) $\ln C = -2.28 + .183 \ln ULCN + .177 \ln UMCN or \ln UMCN$</td>
<td>[.21] [.14] [1.6]</td>
<td>.987</td>
<td>.0037</td>
<td>.00007</td>
<td>2.48**</td>
<td>.74 [3.7]</td>
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<tr>
<td>(19) $\ln C = -1.95 + .268 \ln ULCN + .237 \ln UMCN or \ln UMCN$</td>
<td>[.17] [.24] [2.6]</td>
<td>.977</td>
<td>.0042</td>
<td>.00012</td>
<td>3.07**</td>
<td>.72 [3.4]</td>
</tr>
<tr>
<td>(20) $\ln C = -.405 + .341 \ln ULCN + .813 \ln UMCN or \ln UMCN$</td>
<td>[.88] [.38] [9.8]</td>
<td>.993</td>
<td>.0025</td>
<td>.00004</td>
<td>2.74**</td>
<td></td>
</tr>
<tr>
<td>(21) $\ln C = -.397 + .328 \ln ULCN + .821 \ln UMCN or \ln UMCN$</td>
<td>[.8] [.35] [9.6]</td>
<td>.994</td>
<td>.0026</td>
<td>.00004</td>
<td>2.62**</td>
<td></td>
</tr>
<tr>
<td>(22) $\ln C = -5.34 + .294 \ln ULCN + .874 \ln UMCN or \ln UMCN$</td>
<td>[.12] [.5] [11.2]</td>
<td>.992</td>
<td>.0024</td>
<td>.00004</td>
<td>2.36**</td>
<td></td>
</tr>
<tr>
<td>'Mixed' Model Results</td>
<td>Const.</td>
<td>ΔlnULCN</td>
<td>Δ(lnULC- lnULCN)</td>
<td>ΔlnUMC or ΔlnUMCN</td>
<td>ΔlnUKCN</td>
<td>ln(CU) or (+) ln(CU)</td>
</tr>
<tr>
<td>-----------------------</td>
<td>--------</td>
<td>---------</td>
<td>----------------</td>
<td>-----------------</td>
<td>---------</td>
<td>----------------</td>
</tr>
<tr>
<td>Equation (21)</td>
<td>.005</td>
<td>.007</td>
<td>-.082</td>
<td>1.14</td>
<td>.230</td>
<td>.935</td>
</tr>
<tr>
<td></td>
<td>[3.4]</td>
<td>[.04]</td>
<td>[.4]</td>
<td>[5.4]</td>
<td>[1.3]</td>
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<tr>
<td>Equation (22)</td>
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<td>-.086</td>
<td>-.193</td>
<td>1.28</td>
<td>.155</td>
<td>.951</td>
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<tr>
<td></td>
<td>.004</td>
<td>.208</td>
<td>.202</td>
<td>1.01</td>
<td>.407</td>
<td>.920</td>
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<td>[3.0]</td>
<td>[2.2]</td>
<td>[2.2]</td>
<td>[5.1]</td>
<td>[2.0]</td>
<td></td>
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<tr>
<td>Equation (23)</td>
<td>-.001</td>
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<td>1.21</td>
<td>1.04</td>
<td>.103</td>
<td>.955</td>
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<td>[5.9]</td>
<td>[5.8]</td>
<td>[1.9]</td>
<td></td>
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<tr>
<td>Equation (24)</td>
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<td>1.07</td>
<td>.093</td>
<td>.959</td>
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<td>[.1]</td>
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</tr>
<tr>
<td></td>
<td>-.001</td>
<td>.265</td>
<td>1.23</td>
<td>1.03</td>
<td>.106</td>
<td>.955</td>
</tr>
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<td>[.8]</td>
<td>[5.0]</td>
<td>[9.2]</td>
<td>[6.7]</td>
<td>[3.2]</td>
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</tr>
</tbody>
</table>

TABLE 3 (concluded)

OLS RESULTS FOR TOTAL MANUFACTURING SECTOR
increasing returns to scale with an output-labour elasticity of .09 and an output-materials elasticity of 1.15, thus remained the only satisfactory equation. These short-run elasticities are, however, unlikely to be consistent with the relevant long-run shares of manufacturing income, and so this equation too must be rejected as unsatisfactory.

An explicit productivity influence was tested for, by splitting the wage rate variable into separate unit labour cost and labour-productivity variables, but the separate influence was rejected through there being an incorrect positive sign on its coefficient.

No sensible results were obtained when the net value added price deflator was used as the dependent variable.

"Target-return" Model

There is no evidence available to support any form of "target-return" hypothesis. In the unrestricted form equations (9) and (10), the coefficients on the normal unit materials cost variables should not be negative and the coefficients on the normal unit labour costs variables are significantly different from unity. Consequently, the restricted form equations (9') and (10') are clearly not consistent with the data, it is not possible to conduct the Nordhaus "optimal pricing" test, and little useful purpose can be served by comparing the (very unstable) coefficients of the \( \ln(K/YN) \) and \( \Delta \ln(K/YN) \) variables with the Hancock values of .15 and .25.

"Full-cost" Model

None of the hypotheses postulated can be accepted, for either price deflator as the dependent variable, or for levels or change
form equations. Apart from there being very real problems with autocorrelated residuals (even after first-order correction using the Cochrane-Orcutt technique), equations (13) and (14) showed there to be no evidence of a constant mark-up on full costs (but rather the unlikely occurrence of a mark-down due to $\alpha_1$ and $\alpha_1^*$ both being $<1$). There is also no statistical justification for running each of these regressions without a constant term, as the hypotheses that $\alpha_0 = 0$ and $\alpha_0^* = 0$ could not be accepted. Equations (15) and (16) showed there to be no evidence of a mark-up varying positively with excess demand.

"Modified Mark-up" or "Mixed" Models

None of the three-part "modified mark-up" hypotheses postulated in equations (17) to (20) can be accepted, as all excess demand variables (whether in total, or in positive and negative deviations form) fail to be significant and of correct sign. Equations omitting excess demand variable(s) are therefore then reported, so as to obtain some indication of whether either of the remaining two parts of the three-part Schultze and Tryon hypothesis can be accepted. The longer run two-part hypothesis incorporating normal unit capital costs cannot be accepted, as although all coefficients are positive and significant, the coefficient on (lnULC-lnULCN) is much greater than that on lnULCN and leads to an unacceptable negative lnULCN influence. The shorter-run hypothesis that prices are set (i) by markups on normal unit labour costs and on unit materials costs and (ii) according to temporary changes in labour costs which are greater than normal unit labour costs, cannot be rejected (although the Durbin-Watson test is indeterminate). Thus this form of "modified mark-up" hypothesis cannot be rejected and is further not
consistent with constant mark-up "full-cost" hypothesis requirements.

None of the full "mixed" model hypotheses postulated in equations (21) to (24) can be accepted, as all excess demand variables again fail to be significant and of correct sign. The equations reported which omit excess demand variable(s) produce results very similar in nature to those obtained for the "modified mark-up" model, in that the equation incorporating normal unit capital costs is rejected because of the size of the \( \Delta(\ln ULC - \ln ULCN) \) coefficient and the remaining equation cannot be rejected. The corresponding shorter-run hypothesis indicates that changes in normal unit labour costs and changes in unit materials costs are significant, as are temporary changes in unit labour costs. The overall influence of actual unit labour costs is, however, very much quantitatively greater than the negligible influence of normal unit labour costs (as \( \gamma_1 - \gamma_2 \approx 0 \)), so much so that this equation is almost identical with the unrestricted form presented as the fourth equation in Table 3. The equation is clearly not consistent with the change form of the "full-cost" hypothesis, but would have been consistent with the "classical" hypothesis if the excess demand variable had been significant.

Hence, the only satisfactory result for the Total Manufacturing Sector comes from a modified "mixed" model or modified "classical" model, and involves the implicit price deflator being determined by a constant amount per annum, together with differing constant markups on unit labour costs and unit materials costs. This result is derivable from any one and all of the following three equations, thus indicating the result to
be a relatively stable one.

\[ \Delta \ln P = 0.004 + 0.205 \Delta \ln ULC + 1.02 \Delta \ln UMC \quad R^2 = .920 \\
[3.2] \quad [2.4] \quad [5.5] \quad D.W. = 2.32* \]

\[ \Delta \ln P = 0.004 + 0.208 \Delta \ln ULCN + 0.202 \Delta (\ln ULC - \ln ULCN) + 1.01 \Delta \ln UMC \quad R^2 = .920 \\
[3.0] \quad [2.2] \quad [2.2] \quad [5.1] \quad D.W. = 2.30* \]

\[ \ln P = -1.95 + 0.248 \ln ULCN + 0.237 (\ln ULC - \ln ULCN) + 1.191 \ln UMC \quad R^2 = .977 \\
[1.7] \quad [2.4] \quad [2.6] \quad [3.4] \quad D.W. = 3.07** \]

(b) **Industries**

"Classical" Model

For none of the 23 industries could either of the "classical" model hypotheses (1) and (2) be accepted, as no excess demand variable was positive and significant at the 5% level of significance.

With respect to the influence of unit capital costs, the only stable positively significant coefficient was for Industry 10 (Paper, Stationery and Printing). These results confirm those found for the Total Manufacturing Sector and suggest either that Nordhaus was correct about the lack of role for capital costs in a "classical" equation, or more likely (since we cannot accept a "classical" equation for even one industry) that our (biased) measure of capital costs is not sufficiently good.

For a further six industries (2.5, 3.1, 3.3, 4.2, 7.1, and 7.3) were both short-run unit labour and material costs significant, and whether these can be finally accepted or rejected will depend on the "mixed" model results.

"Neo-classical" Model

For all 23 industries, no longer run "neo-classical" model
could be accepted in either unrestricted or restricted coefficient form.

With the short-run model hypotheses, however, potentially plausible results were obtained for a number of industries.

For those industries in which the time trend variable provided a significant correctly signed additional influence (i.e., 1.2, 2.4, 2.5, 3.1, and 3.2), the former three (i.e., 1.2, 2.4, and 2.5) had implausible elasticities whose sum was in excess of 1.6, and the latter (i.e., 3.2, Machinery) was consistent with an hypothesis of increasing returns to scale with output-labour elasticity of .5, output-materials elasticity of .6, and a Hicks-neutral technical progress contribution of 1.7%. For industry 3.1 (Metal Manufactures), the hypothesis of constant returns to scale could not be rejected; the output-labour elasticity was .4, the output-materials elasticity was .6, and the Hicks-neutral technological progress contribution was 1.3%.

Industries for which the time trend variable was not a significant additional influence, and therefore for which wage rate per employee and unit material costs were the only significant variables, were industries 2.2, 7.4, and 10 exhibiting increasing returns to scale (and probably implausible output-materials elasticities of .9, 1.0, and 1.1, respectively), industries 2.3, 4.2, 6, 7.2, and 8.1 exhibiting decreasing returns to scale (and generally quite plausible elasticities), and industry 7.1 (Confectionery) for which the constant returns to scale restrictions could not be rejected (the respective elasticities being .15 and .85).
"Target-return" Model

When tested in unconstrained form, for no industry were the requirements of $\alpha_0 = 0$, $\alpha_2 = 1$, and $\alpha_3 = 1$, or $\beta_0 = 0$, $\beta_2 = 1$, and $\beta_3 = 1$ satisfied. Nor were the coefficients on the three non-constant term variables ever significant and of correct sign.

When tested in the constrained form of equation (9°), two industries (2.1, Chemicals and Fertilizers, and 12, Plastic Products) satisfied the major requirement that $\alpha_1$ be significantly greater than zero. However in both cases there was probable first-order serial correlation of the residuals, and when this was corrected for $\alpha_1$ did not remain significant. Additionally, the overall restriction required by (9°) could not be accepted, and so for no industry can the "target-return" model be accepted.

"Full-cost" Model

There are no satisfactory results at the industry level.

"Modified Mark-up" or "Mixed" Models

None of the three part "modified mark-up" hypotheses of equations (17) to (20) nor any of the full "mixed" model hypotheses of equations (21) to (24) could be accepted, as all excess demand variables failed to be significant and of correct sign.

No lesser form of either short run or longer run "modified mark-up" hypothesis could be accepted.

With respect to "mixed" model equations omitting the excess demand variable, the industry longer run model results were consistent with that for the Total Manufacturing Sector, viz: all equations incorporating normal unit capital costs had to be rejected. For the shorter run model, five industries (3.1, 3.3,
4.2, 7.1, and 10) produced results which indicated changes in normal unit labour costs, temporary changes in unit labour costs, and unit materials costs were significant variables. Further analysis of the values of these coefficients showed that for two of these industries (i.e., 4.2 and 10) the overall normal unit labour costs influence was unacceptably negative, for a further two industries (i.e., 3.3, Motor Vehicles and Parts, and 7.1, Confectionery) the influence of actual unit labour costs is quantitatively greater than the negligible overall influence of normal unit labour costs (and is therefore not inconsistent with the corresponding reduced "classical" model result), while for the other industry (i.e., 3.1, Metal Manufactures) a quantitatively significant positive influence existed for normal unit labour costs in addition to that for actual unit labour costs.

Hence, for all 23 industries there was no significant excess demand influence, and for the majority of the 23 industries, all hypotheses had to be rejected. For the remaining industries, it can be concluded:

**pricing behaviour in Industry 10** (Paper, Stationery, and Printing) is not inconsistent with a modified "classical" equation incorporating unit capital costs

\[
(\text{Ind.10}) \Delta \ln P = 0.002 + 0.296 \Delta \ln ULC + 0.701 \Delta \ln UMC \\
\begin{bmatrix}
[1.7] \\
[5.6] \\
[7.1] \\
\end{bmatrix} \\
+ 0.059 \Delta \ln UKC \quad R^2 = 0.970 \\
\begin{bmatrix}
[2.5] \\
\end{bmatrix} \\
\text{D.W.} = 2.27^* \\
\]

**pricing behaviour in Industry 3.2** (Machinery) is not inconsistent with a short-run "neo-classical" equation incorporating the wage rate per employee and unit material costs and reflecting increasing returns to scale and Hicks-neutral technological process
\( \text{(Ind.3.2) } \ln P = -0.527 + 0.509 \ln \frac{W}{L} + 0.623 \ln \frac{M}{Y} \)  
\[ \begin{array}{c} \text{[.7]} \text{[3.1]} \text{[10.5]} \end{array} \]  
\( -0.017 \)  
\( R^2 = 0.977 \)  
\[ \begin{array}{c} \text{[2.3]} \end{array} \]  
\( D.W. = 1.77* \)

**pricing behaviour in Industries 2.3, 4.2, 6, 7.2, and 8.1** is not inconsistent with a short-run "neo-classical" equation reflecting decreasing returns to scale

\( \text{(Ind.2.3) } \ln P = 1.34 + 0.307 \ln \frac{W}{L} + 0.399 \ln \frac{M}{Y} \)  
\[ \begin{array}{c} \text{[1.5]} \text{[6.4]} \text{[2.2]} \end{array} \]  
\( R^2 = 0.810 \)  
\( D.W. = 1.66* \)

\( \text{(Ind.4.2) } \ln P = 1.32 + 0.117 \ln \frac{W}{L} + 0.596 \ln \frac{M}{Y} \)  
\[ \begin{array}{c} \text{[2.1]} \text{[7.1]} \text{[4.8]} \end{array} \]  
\( R^2 = 0.838 \)  
\( D.W. = 2.27* \)

\( \text{(Ind.6) } \ln P = 0.998 + 0.239 \ln \frac{W}{L} + 0.545 \ln \frac{M}{Y} \)  
\[ \begin{array}{c} \text{[4.9]} \text{[8.1]} \text{[8.7]} \end{array} \]  
\( R^2 = 0.982 \)  
\( D.W. = 1.48* \)

\( \text{(Ind.7.2) } \ln P = 0.753 + 0.166 \ln \frac{W}{L} + 0.667 \ln \frac{M}{Y} \)  
\[ \begin{array}{c} \text{[1.0]} \text{[6.5]} \text{[3.7]} \end{array} \]  
\( R^2 = 0.949 \)  
\( D.W. = 1.61* \)

\( \text{(Ind.8.1) } \ln P = 0.552 + 0.042 \ln \frac{W}{L} + 0.836 \ln \frac{M}{Y} \)  
\[ \begin{array}{c} \text{[2.2]} \text{[4.1]} \text{[17]} \end{array} \]  
\( R^2 = 0.968 \)  
\( D.W. = 1.49* \)

**pricing behaviour in Industry 3.3** (Motor Vehicles and Parts) is not inconsistent with a modified "classical" equation incorporating unit materials and unit labour costs only, a result confirmed by our modified "mixed" model equation

\( \text{(Ind.3.3) } \Delta \ln P = 0.006 + 0.296 \Delta \ln ULC + 0.201 \Delta \ln UMC \)  
\[ \begin{array}{c} \text{[3.1]} \text{[11.8]} \text{[4.4]} \end{array} \]  
\( R^2 = 0.951 \)  
\( D.W. = 1.84* \)

\[ \Delta \ln P = 0.006 + 0.299 \Delta \ln ULC + 0.296 \Delta (\ln ULC - \ln ULCN) \]  
\[ \begin{array}{c} \text{[2.7]} \text{[6.3]} \text{[11.1]} \end{array} \]  
\( + 0.195 \Delta \ln UMC \)  
\( R^2 = 0.951 \)  
\( D.W. = 1.89* \)

for Industry 3.1 (Metal Manufactures), our data were not inconsistent with two pricing behaviour hypotheses. One hypothesis was the modified "mixed" model equation reflecting significant positive normal unit labour cost
influence in addition to unit labour cost and unit materials cost influences; the other hypothesis was in the short-run "neo-classical" equation exhibiting constant returns to scale and Hicks-neutral technological progress

\[
\Delta \ln P = 0.004 + 0.359 \Delta \ln ULCN + 0.285 \Delta (\ln ULC - \ln ULCN) \\
\quad + 0.495 \Delta \ln UMC \\
\quad \text{[1.5] [2.7] [2.3]} \\
\quad \text{[3.7]} \\
\quad R^2 = 0.837 \\
\quad \text{D.W.} = 2.33^* \\
\ln P = 0.075 + 0.402 \ln (W/L) + 0.597 \ln (M/Y) \\
\quad \text{[0.1] [2.7] [7.0]} \\
\quad - 0.013 t \\
\quad \text{[2.0]} \\
\quad R^2 = 0.958 \\
\quad \text{D.W.} = 1.66^*
\]

for Industry 7.1 (Confectionery), our data were also not inconsistent with two pricing behaviour hypotheses. One hypothesis was the modified "classical" equation incorporating unit labour and unit materials costs only, confirmed by the modified "mixed" model equation; the other basic hypothesis was in the short run "neo-classical" equation exhibiting constant returns to scale

\[
\Delta \ln P = 0.005 + 0.471 \Delta \ln ULC + 0.379 \Delta \ln UMC \\
\quad \text{[1.0] [3.3] [2.8]} \\
\quad \text{D.W.} = 2.11^* \\
\Delta \ln P = 0.005 + 0.477 \Delta \ln ULCN + 0.458 \Delta (\ln ULC - \ln ULCN) \\
\quad \text{[0.9] [2.9] [2.3]} \\
\quad + 0.378 \Delta \ln UMC \\
\quad \text{[2.7]} \\
\quad R^2 = 0.949 \\
\quad \text{D.W.} = 2.09^* \\
\ln P = -0.012 + 0.155 \ln (W/L) + 0.851 \ln (M/Y) \\
\quad \text{[0.1] [2.5] [9.0]} \\
\quad R^2 = 0.985 \\
\quad \text{D.W.} = 1.77^*
\]

Finally, it was pointed out in Hall [9, pp. 30-31] that it was hoped to determine in this paper whether industry pricing behaviour was significantly related to such additional factors as nominal or effective tariff protection, industry sales concentration,
degree of overseas control, and financial performance. Table 4 summarises these additional industry characteristics for all 23 industries, and no obvious relationships seem apparent.

(iv) Cross Section Results

Cross section analysis was conducted for three representative time periods: the year 1956-57, being at the beginning of our time series sample and having the highest mean implicit price deflator percentage change (3.66% ΔP for the 23 industries); the year 1962-63, being towards the middle of our sample and showing a significant mean implicit price deflator decline (-1.03% ΔP); and the year 1966-67, near the end of our sample period and having a high mean implicit price deflator percentage change (2.25% ΔP).

Hypotheses tested were those in the "classical", "neo-classical", "target-return", and "mixed" categories.

For every year, all hypotheses in the "classical", "target-return", and "mixed" model categories could not be accepted. Furthermore, no excess demand variable was significant, and in most equations only the relevant materials cost variable was significant. These results would perhaps suggest that in general the industries in our cross-section sample are too diversified for any one hypothesis to hold across all industries, and also that it is not realistic to suggest possibly different hypotheses for years of differing mean percentage implicit price deflator change.

For the "neo-classical" model hypotheses (without a time trend variable, of course), no equation in unrestricted form had all coefficients significant at the 5% level. In the short-run case, this was due to insignificant wage rate variables, and in the
**TABLE 4**

<table>
<thead>
<tr>
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<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>1.2 Bricks</td>
<td>All rejected</td>
<td>48</td>
<td>33</td>
<td>52</td>
<td>15.2</td>
</tr>
<tr>
<td>1.3 Cement &amp; plaster</td>
<td>All rejected</td>
<td>28</td>
<td>.19</td>
<td>.61</td>
<td>16.7</td>
</tr>
<tr>
<td>2.1 Chemicals &amp; fertilizers</td>
<td>All rejected</td>
<td>36</td>
<td>18</td>
<td>51</td>
<td>9.9</td>
</tr>
<tr>
<td>2.2 Pharmaceutical</td>
<td>All rejected</td>
<td>68</td>
<td>35</td>
<td>29</td>
<td>25.4</td>
</tr>
<tr>
<td>2.3 Soaps &amp; detergents</td>
<td>Short run &quot;neo-classical&quot;, decreasing returns to scale</td>
<td>35</td>
<td>.19</td>
<td>.64</td>
<td>20.1</td>
</tr>
<tr>
<td>2.4 Paints, polishes, etc.</td>
<td>All rejected</td>
<td>62</td>
<td>38</td>
<td>.68</td>
<td>15.3</td>
</tr>
<tr>
<td>2.5 Oil &amp; fuel</td>
<td>All rejected</td>
<td>3</td>
<td>1</td>
<td>.84</td>
<td>11.0</td>
</tr>
<tr>
<td>3.1 Metal manufacturers</td>
<td>Modified &quot;mixed&quot; or short run constant returns &quot;neo-classical&quot;</td>
<td>80</td>
<td>37</td>
<td>59</td>
<td>10.4</td>
</tr>
<tr>
<td>3.2 Machinery</td>
<td>Short run &quot;neo-classical&quot;, increasing returns to scale</td>
<td>50</td>
<td>34</td>
<td>19</td>
<td>11.0</td>
</tr>
<tr>
<td>3.3 Motor vehicles &amp; parts</td>
<td>Modified &quot;mixed&quot; or &quot;classical&quot;</td>
<td>67</td>
<td>36</td>
<td>75</td>
<td>18.2</td>
</tr>
<tr>
<td>4.2 Clothing</td>
<td>Short run &quot;neo-classical&quot;, decreasing returns to scale</td>
<td>74</td>
<td>41</td>
<td>13</td>
<td>16.1</td>
</tr>
<tr>
<td>5.1 Wool scouring, etc.</td>
<td>All rejected</td>
<td>0</td>
<td>0</td>
<td>77</td>
<td>7.1</td>
</tr>
<tr>
<td>6 Footwear</td>
<td>Short run &quot;neo-classical&quot;, decreasing returns to scale</td>
<td>68</td>
<td>41</td>
<td>33</td>
<td>16.4</td>
</tr>
<tr>
<td>7.1 Confectionery</td>
<td>Modified &quot;mixed&quot; or &quot;classical&quot; or short run constant returns &quot;neo-classical&quot;</td>
<td>39</td>
<td>37</td>
<td>76</td>
<td>12.6</td>
</tr>
<tr>
<td>7.2 Brewing, etc.</td>
<td>Short run &quot;neo-classical&quot;, decreasing returns to scale</td>
<td>16</td>
<td>12</td>
<td>72</td>
<td>13.7</td>
</tr>
<tr>
<td>7.3 Animal &amp; vegetable oils</td>
<td>All rejected</td>
<td>5</td>
<td>4</td>
<td>98</td>
<td>9.6</td>
</tr>
<tr>
<td>7.4 Food &amp; drinks</td>
<td>All rejected</td>
<td>19</td>
<td>15</td>
<td>25</td>
<td>12.0</td>
</tr>
<tr>
<td>7.5 Tobacco products</td>
<td>All rejected</td>
<td>30</td>
<td>48</td>
<td>99</td>
<td>23.8</td>
</tr>
<tr>
<td>8.1 Timber products</td>
<td>Short run &quot;neo-classical&quot;, decreasing returns to scale</td>
<td>22</td>
<td>15</td>
<td>22</td>
<td>12.3</td>
</tr>
<tr>
<td>9 Furniture</td>
<td>All rejected</td>
<td>54</td>
<td>36</td>
<td>21</td>
<td>19.7</td>
</tr>
<tr>
<td>10 Paper, etc.</td>
<td>Modified &quot;classical&quot;, with unit capital costs</td>
<td>37</td>
<td>29</td>
<td>25</td>
<td>15.6</td>
</tr>
<tr>
<td>11 Tires, rubber, etc.</td>
<td>All rejected</td>
<td>33</td>
<td>23</td>
<td>93</td>
<td>9.7</td>
</tr>
<tr>
<td>12 Plastic products</td>
<td>All rejected</td>
<td>55</td>
<td>37</td>
<td>48</td>
<td>15.7</td>
</tr>
<tr>
<td>Manufacturing Sector</td>
<td>Modified &quot;mixed&quot; or &quot;classical&quot;</td>
<td>46</td>
<td>28</td>
<td>—</td>
<td>12.8</td>
</tr>
</tbody>
</table>

*See Tariff Board, Annual Report 1971, p. 23 and p.49 for further explanation of terms.*
longer run case it was generally due to both insignificant wage rate and capital cost variables. However, when the constant returns to scale restrictions were imposed several surprising results emerged for the individual cross-section years 1962-63, 1965-66, and 1966-67. Results for 1955-56, 1956-57, and 1961-62 were again rejected, but for each of 1962-63 and 1965-66 the short-run hypothesis could not be rejected, while for 1966-67 the longer-run hypothesis could not be rejected. The latter results are presented in Table 5, and as far as the short-run results are concerned tend to suggest the hypothesis holds whether mean prices have decreased or increased.

**TABLE 5**

"Neo-Classical" Results for the Cross Sections 1962-63, 1965-66, and 1966-67

<table>
<thead>
<tr>
<th>Year</th>
<th>Const.</th>
<th>ln(W/L)</th>
<th>ln(M/Y) or ln(M/YN)</th>
<th>ln(D/YN)</th>
<th>R²</th>
<th>SEE</th>
<th>RSS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1962-63</td>
<td>-.078</td>
<td>.196</td>
<td>.817</td>
<td></td>
<td>.852</td>
<td>.0298</td>
<td>.01782</td>
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<tr>
<td></td>
<td>[.1]</td>
<td>[.9]</td>
<td>[10.7]</td>
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III Summary and Conclusions

In view of the previously virtually unknown quality of the implicit price deflator and other data used in this research, the econometric results obtained to date have not been as uninformative as expected.

Nevertheless, the particular results of importance are primarily negative in nature in the sense that almost all cross-section results had to be rejected, as did all time series hypotheses for a majority of the 23 manufacturing industries tested. No positive and significant excess demand influence was detected at any stage, and in almost all industries unit capital cost influences (and almost by definition any longer-run hypotheses as well) had to be rejected. It is distinctively possible that in each of these two cases the data used are partly to blame. The excess demand variable has already been acknowledged as particularly crude and simple, but this category of influence on prices will be more thoroughly tested with quarterly data on inventory and excess demand for labour movements from the Department of Industry and Commerce and ACMA/Wales Surveys (see Saunders [19] and Hall [10] respectively); the capital costs measure has also previously been acknowledged as imperfect as it reflects (imperfectly) only the depreciation component of unit capital costs and therefore will almost certainly be downwardly biased of unknown degree. It seems not worthwhile persevering with the use of PVA as a dependent variable (especially if we are to be concerned with final prices rather than returns to labour and capital services) as no results with these equations were superior to those obtained from the P equations. There seems no obvious relation between accepted/rejected hypotheses and such
additional industry factors as degree of tariff protection, degree of sales concentration, degree of foreign control, and standard of financial performance. A greater degree of disaggregation, perhaps as far as the 4 digit level, may well be necessary for anything conclusive to be said on these important matters, though.

It is suggested that the outlook for future work with more up-to-date (i.e., post-1967-68) annual data is far from bright but not completely hopeless. Clearly the desirable situation would be to undertake the type of tests conducted in this paper and to evaluate the robustness of the results obtained, wholesale prices rather than implicit price (ex factory) deflators being preferred as the dependent variable. Unfortunately, the availability on a consistent basis of the former seems much further off than the latter, and even for the latter the small number of time series observations since 1968-69 (together with the added complication of the break caused by there being no 1970-71 Manufacturing Establishments' Census) means time series work will clearly not be possible for a considerable number of years yet. The very small sample time series results presented in this paper need updating and challenging, but the challenging with more recent data seems likely to have to wait. What therefore of the future for cross-section analysis? This would in principle be more hopeful than for time series analysis, but it must be recalled that the cross-section results presented in this paper must be interpreted either as being of little use (apart from some non-rejectable results being obtained for later years) or as being consistent with the conclusion that Australian manufacturing industry is very diverse in nature and unlikely to conform to a unique price determination hypothesis.
To overcome the latter problem, a far greater degree of industry disaggregation would be required to provide sufficient suitable cross-section observations, unless mixed time series cross-section data were to be used.

Hence, in the meantime, the most fruitful task towards fitting a few more pieces into the empirical price determination jigsaw puzzle will be to test the two basic sets of quarterly sample survey data available - but the form of these data will not allow either the thorough testing of alternative change form hypotheses or any hypotheses at all in levels form.

What can we evaluate as progress made to date on price determination in the Manufacturing Sector? Although the results presented in this paper are not directly comparable with those of Hancock [11] (due to his having used a composite explanatory variable for labour, materials, and capital input costs (i.e., $\Delta \ln(\text{W+M+D/L})$), and to his having used costs per unit of labour rather than costs per unit of output), our results would tend, at this stage, not to support his conclusions with respect to the influence of capital costs and also not to support the conclusions of both he and Whitehead [24] with respect to a significant productivity influence. Our results tend to suggest that such simple (composite explanatory variable) relationships as formulated by Hancock and by Whitehead may well hold up principally because of the high level of aggregation and will break down with further disaggregation and more rigorously formulated and tested hypotheses. With respect to oligopolistic versus competitive influences, it is suggested these results throw no further light on this question, and so the Norton, Schott and Sweeney [15] and Hawkins, Kelly and Lightfoot [12] conjectures must remain
unchallenged. On the question of the mark-up assertion of Bentley, Collins and Drane [1], Hancock [11] has already cast considerable doubt on the constant nature of such mark up. All we can say in addition is that no "full cost" markup (constant or variable) hypothesis could be accepted, and several "modified mark-up" equations (without capital cost and excess demand influences) could not be rejected.

Thus, our major conclusions are not the narrow ones that most of the hypotheses tested had to be rejected and that certain hypotheses could not be rejected for certain industries, but rather come from the broader and far more pessimistic lessons relating to the usefulness of the type of data used (i.e., annual implicit price deflators and imperfect measures for demand and capital cost influences) and whether any useful work will be possible in the future when all appropriate data from 1968-69 on are available.

Should our pessimism turn out to be justified, then we must continue to remain ignorant on the issues of relative price behaviour and price setting procedures at the sector and industry level in Australia - an unhappy situation while inflation and structural unemployment are such important and pressing empirical problems.
1 These two tasks are but part of a much wider program of research into pricing behaviour in Australian Manufacturing Industries. See Hall [9].

2 As explained in Hall [9], pp. 30-31, this classification for Manufacturing Industry is that of the Tariff Board rather than of the Commonwealth Bureau of Census and Statistics. Clearly, therefore, this study supplements rather than duplicates the recent study by Hancock [11]. Hancock's study also had significantly different aims and in particular was not primarily concerned with testing alternative price determination hypotheses.

3 See Hall [9], pp. 31-33, for an explanation of why time series have to be broken between 1967-68 and 1968-69, and why detailed series from 1968-69 are not yet available.

4 Hancock ([11], p. 65) has recently commented that, for the economy as a whole, "The piecing-together of the large jigsaw-puzzle of price determination has scarcely begun."

5 See, for example, Nordhaus [13], Eckstein and Wyss [7], Earl [4], Ripley and Segal [18], Popkin [16] and [17], Straszheim and Straszheim [21], and Wilder, Williams, and Singh [25], which developed out of earlier work by Schultze and Tryon [20], and Eckstein and Fromm [6].

6 Additional existing studies initially considered as being of possible relevance were the various versions of the Reserve Bank of Australia RBA and RBF Models, and the various versions of the Australian Treasury/Australian Bureau of Statistics.
NIF Models. These Models, like the work of Norton, Schott, and Sweeny [14], and Hawkins, Kelly, and Lightfoot [12], are primarily concerned in their pricing work with implicit price deflators of aggregate or disaggregated components of national expenditure or production.

7 Davidson [3], p. 584.

8 Whitehead [24], p. 189.

9 Whitehead [24], p. 189, fn. 8.

10 Hancock [11], p. 55.

11 Hancock [11], pp. 61-62, fn. 9.

12 Hancock [11], p. 54.

13 Norton, Schott and Sweeny [15], p. 18.

14 Hawkins, Kelly and Lightfoot [12], p. 42.

15 See Hall [9] for recent detailed documentation of these problems.

16 Hawkins, Kelly and Lightfoot [12], p. 42.

17 Bentley, Collins and Drane [1], p. 494.

18 Committee to Advise on Policies for Manufacturing Industry [2], Ch. 2, pp. 29-30.

19 Ibid., p. 30.

20 Hall [9], p. 30.

21 Tariff Board, Annual Report, 1971 [22], Table 4, Appendix 2, p. 45.

22 Ibid., p. 16.

23 Idem.
Ibid., p. 24.


For example, no explicit excess demand variable has been tested.

Both Whitehead and Hancock make this point explicitly.

This was because statistical coverage figures relating to the implicit price deflator denominator series (i.e. the Industry Indexes of Volume of Production presented in Table 3 on p. 44 of the Annual Report of the Tariff Board, 1970-71) were only 21% for Industry 1.1, 0% for 3.4, 70% for 4.1, 69% for 4.3, 46% for 5.2, 22% for 8.2, 0% for 13.1, and 14% for 13.2. Although coverage for Industry 3.3 (Motor Vehicles and Parts) was only 42%, this sub-division was retained for the econometric work because of its importance within Australian Manufacturing Industry.

Hall [9], pp. 29-30.

For recent attempts to investigate the relationship between relative prices and the general price level, see Vining and Elwertowski [23].

For example, see the comments by Nordhaus [14], p. 27 and p. 45.

Popkin [16], p. 486.

The particular capital costs variable used in this research is clearly far from ideal, and Hancock [11], p. 57 has outlined thoroughly the problems involved in obtaining appropriate
data. Hancock's procedure of taking either 15% or 25% of the reported values of the capital stock as a capital input cost figure for every industry is said by him to produce a smaller bias than omitting the capital variable completely. In this work, we attempt to overcome the omission bias rather differently. The capital costs variable is still clearly biased (except for industries where taxation is neutral and depreciation and interest costs remain directly proportional) as reported depreciation charges only are included (see Nordhaus [13], p. 29 or p. 41 for the correct variable), but at least this doesn't impose capital input costs as a common constant percentage of capital stock for all industries.

34 See Hall [9], pp. 7-8, on import and export price indices and on the SITC classifications differing from the Tariff Board and ASIC classifications.

35 Note that none of these basic hypotheses includes an expected inflation variable. This is because there are no suitable consistently classified direct measures available for either individual industry or manufacturing sector price expectations, and because there are insufficient time series observations in our sample to allow the imposition of a price expectations formation hypothesis based on previous actual prices. Michael Parkin has further pointed out that the basic models must therefore be best interpreted as models of relative not absolute price determination, and that if data were available, all these hypotheses would have to be augmented by the expected rate of inflation with the prediction that the equation will be degree one homogeneous in all money prices (expected inflation and unit cost) if no long-run
trade-off between excess demand and price change holds.

36 Eckstein and Fromm [6], see especially p. 1163.

37 The simplest possible measure of the industry operating rate/level of capacity utilization had to be chosen (viz: - the deviation of actual from trend real output, as per Nordhaus and Godley [14], p. 875, note 9), due to there being only thirteen time series observations available.

38 All hypotheses are set up and tested in natural log form, and are stated for the implicit ex-factory selling price deflator only. Where relevant, the corresponding hypotheses for the net value added price deflator would merely omit the material costs variable (as PVA reflects the price set to cover the rate of return from utilizing labour and capital services only).

39 For some such different types and some idea of the potential number of alternatives, see Nordhaus [13], pp. 28-29.

40 For an example of the imposing and testing of much more complex parameter restrictions within a simultaneous equation framework, see Hall [8].

41 Hawkins, Kelly and Lightfoot [12], pp. 36-42.

42 Eckstein and Fromm [6], pp. 1165-66, Eckstein and Wyss [7], pp. 134-40.

43 Prior to the compilation of data series for real depreciated capital stock levels, an approximate form of equation (7) was set up and tested. This involved taking normal unit capital costs (UKCN) as a (downward biased) approximation to ($\frac{\pi_t}{Y_t}$) and testing for the coefficient $a_1 > 1$. This seems equivalent to testing whether the target has been achieved or not,
rather than obtaining an estimate of $\hat{\Pi}$, i.e.,

\begin{align}
(9') \quad \ln P &= \alpha_0'' + \alpha_1'' \ln UCN + \alpha_2'' \ln UCN + \alpha_3'' \ln UCN \\
(9'') \quad (\ln P - \ln UCN - \ln UCN) &= \alpha_0''' + \alpha_1''' \ln UCN
\end{align}

Similarly, hypotheses can be set up to approximate the change form equation (8).

44 In equation (14) (and its corresponding change form), the form \([\ln UCN + \ln UCN + \ln UCN]\) is used in preference to the form \([\ln UCN + UCN + UCN]\) to facilitate possible comparison with the "modified mark-up" or "mixed" model. No ambiguity or need for choice would have arisen if a linear rather than log-linear formulation had been chosen.

45 Schultze and Tryon [20], pp. 284-85, 289.

46 Equations (17) and (19) have to be tested in either non-logarithmic form or with lagged lnUC, as with our limited data base the variables (lnULC - lnULCN) and lnCU (= lnY - lnYN) are exactly collinear.

47 Results are presented in Table 3.

48 Results obtained for the approximate forms explained in footnote 42 confirmed these negative conclusions. For equations (9') and (9'') it was quite clear that the values of the coefficients did not accord with a priori requirements, and in particular the coefficient of lnUKCN in equation (9'') was not $\geq 1$. The equivalent change form equations could not be accepted either, as neither equation had all coefficients both significant and of correct sign.
APPENDIX

1 Definitions of Variables and Sources of the Annual Data for Years Ended 30 June

P = implicit ex-factory selling price deflator, i.e. YVO/Y.
ULC = unit labour costs, i.e. W/Y.
UMC = unit materials costs, i.e. M/Y.
UKC = unit capital costs, i.e. D/Y.
CU = level of capacity utilisation, i.e. Y/YN.
YN = trend volume of production.
t = time trend.
K = level of real depreciated capital stock, i.e. KV/P.
ULCN = normal unit labour costs, i.e. W/YN.
UMCN = normal unit materials costs, i.e. M/YN.
UKCN = normal unit capital costs, i.e. D/YN.
PVA = implicit net value added price deflator, i.e. YV/Y.


W = total wages and salaries; series constructed as for YVO.
M = value of materials and fuel; series constructed

D = capital costs/depreciation on buildings, plant and machinery; series constructed
KV = average annual value of capital stock of land and buildings, plant and machinery; series constructed
L = average annual total employment; series constructed
YV = value of production; Annual Report of the Tariff Board, 1970-71, p. 43, Table 2.

2 Tariff Board Classification of Industries

1 GLASS, BRICKS AND CEMENT
   1.1 Glass and clay products
   1.2 Bricks
   1.3 Cement and plaster products

2 CHEMICALS, FUELS AND PAINTS
   2.1 Chemicals and fertilisers
   2.2 Pharmaceutical and toilet preparations
   2.3 Soaps and detergents
   2.4 Paints, polishes and inks
   2.5 Oil and fuel

3 METAL MANUFACTURES, MACHINERY AND VEHICLES
   3.1 Metal manufactures
   3.2 Machinery
   3.3 Motor vehicles and parts
   3.4 Vessels and other transport equipment

4 TEXTILES AND TEXTILE GOODS
   4.1 Yarn and cloth
   4.2 Clothing
   4.3 Rope, canvas and sacking

5 SKINS AND LEATHER
   5.1 Wool scouring and fellmongering
   5.2 Leather goods, handbags and cases

6 FOOTWEAR

7 FOOD, DRINK AND TOBACCO
   7.1 Confectionery
   7.2 Brewing, winemaking and distilling
   7.3 Animal and vegetable oils
   7.4 Food and drinks
   7.5 Tobacco products
8 TIMBER PRODUCTS
   8.1 Timber milling
   8.2 Wooden products

9 FURNITURE

10 PAPER, STATIONERY AND PRINTING

11 TYRES AND OTHER RUBBER PRODUCTS

12 PLASTIC PRODUCTS

13 MISCELLANEOUS
   13.1 Optical and scientific instruments
   13.2 Jewellery, toys and other products
REFERENCES


WORKING PAPERS IN ECONOMICS

*1 I.G. Sharpe

*2 I.G. Sharpe & R.G. Walker
Asset Revaluation and Stock Market Prices.

*3 N.V. Lam
Incidence and Stabilization Impact of Tin Export Taxation in West Malaysia.

*4 V.B. Hall & M.L. King
Inflationary Expectations in New Zealand: A Preliminary Study.

*5 A.J. Phipps
Strike Activity and Inflation in Australia.

6 N.V. Lam
Incidence of the Rice Export Premium in Thailand.

*7 I.G. Sharpe
Secondary Reserve Requirements, the Monetary Base and the Money Supply in Australia.

8 P. Saunders

9 W.P. Hogan
Economic Strategies for Recovery.

10 T.P. Truong
Asset Revaluation and Share Prices: A Study Using the M.S.A.E. Regression Technique.

11 S. Kim
Instability of Primary Exports, Income Stabilization Policies and Welfare.

*12 I.G. Sharpe & P.A. Volker

13 I.G. Sharpe & P.A. Volker
The Impact of Institutional Changes on the Australian Short-Run Money Demand Function.

14 W.P. Hogan

15 F. Gill
*16 A.J. Phipps  The Impact of Wage Indexation on Wage Inflation and Strike Activity in Australia.

*17 V.B. Hall  Pricing Behaviour in Australia: A Data Evaluation Study.


19 L. Haddad  Economic Systems: Towards a New Classification.

20 G. Lewis  A Strategy for Winning at Roulette.


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