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Market Power in Australian Manufacturing Industry: A Confirmation of Hall's Hypothesis

by

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MARKET POWER IN AUSTRALIAN MANUFACTURING INDUSTRY: A CONFIRMATION OF HALL'S HYPHOTHESIS

ABSTRACT

Robert Hall (1986, 1988, and 1990) has emphasised the importance of imperfect competition and economies of scale in explaining procyclical movements in measured total factor productivity in US industries. In contrast to the labour hoarding hypothesis and real business cycle theorists, he cites the observed procyclical movement in total factor productivity in US industries as evidence against perfect competition, revealing that prices substantially exceed marginal costs. Following the work of Hall (1986, 1988 and 1990), his paper investigates whether the procyclical movements in total productivity in **Australian manufacturing industries** provide some evidence for a particular type of market structure. The main contribution of this paper is the provision of a formal explanation for the difference between the estimated markup ratios and returns to scale by using value added data and gross output data, as highlighted in the work of Domowitz, Hubbard and Peterson (1988), Norrbin (1993) and Basu and Fernald (1995, 1997). Our formal explanation shows that, with the use of value added data, the estimated Solow residual (and hence the markup ratios) are almost twice as large as those obtained with gross output data, because of the two different production functions involved in estimating the Solow residual. Moreover, the main results of the paper, based on the value added data, indicate that the price of most Australian manufacturing industries exceeds their marginal costs, as in the case of the US industries. The highest markup ratios are reported by the chemical and the iron and steel industries. The results also provide evidence that the textile, non-mineral products, other transport and photographic and scientific industries behave as competitive industries.

Key words: Market structure, total factor productivity, economies of scale, imperfect competition.

JEL Classification: C68, L11, L13.

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MARKET POWER IN AUSTRALIAN MANUFACTURING INDUSTRY: A CONFIRMATION OF HALL'S HYPHOTHESIS

Kaludura ABAYASIRI-SILVA[1]

1. Introduction

Recently Robert Hall (1986, 1988, and 1990) has emphasised the importance of imperfect competition in explaining procyclical movement in measured total factor productivity in US industries. In contrast to the labour hoarding hypothesis and real business cycle theorists, he shows that the observed procyclical movement in total factor productivity in US industries as evidence against perfect competition, revealing that, prices substantially exceed marginal costs of those industries.

The importance of Hall's findings and methodology has led further extensions to his pioneering work. Domowitz, Hubbard and Petersen (1988, here in after DHP) and Evans (1992) confirm the empirical findings of Hall that there is a significant positive correlation between total factor productivity changes and aggregate demand variables in most of US industries, revealing a significant evidence for the existence of market power. However, Norrbin (1993) argues that Hall's estimates are subject to a bias due to the use of value added data rather than data on gross output. Thus, by using a series of gross output data for 21 US manufacturing industries and employing the same methodology developed by Hall (1988) he shows that there is no significant positive correlation between aggregate demand variables and the 'Solow Residual'. Thus, Norrbin argues that the findings of his work do not support the proposition of Hall. Moreover, Basu and Fernald (1997) show that, by using data on 34 US industries, a typical US industry has roughly constant returns to scale, implying at most small markups of price over marginal cost. According to them value added estimates differ substantially from gross output estimates and appear less robust. 'Value added is not a natural measure of output and can in general be interpreted as such only with perfect competition. With imperfect competition, the use of value added, even at a firm level, suffers different aggregation bias' (page 251).[1] Nevertheless, following the work of Hulten (1986) and Shapiro (1987), the recent work of Roeger (1995) shows that the observed insignificant correlation between quantity based and price based 'Solow Residuals' (primal and dual productivity measures) in US manufacturing industries, confirms the findings of Hall, that most of US industries are imperfectly competitive.

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[1] That is the normal explanation for the difference in estimates of markup ratios by using value added and gross output data provided by DHP (1988) , Norrbin (1993) and Basu and Fernald (1997). Nevertheless, in this paper we present an alternative formal explanation.

The existence of positive correlation between changes in total factor productivity and output growth in manufacturing industries has been noted in many studies using international and inter industries data from the period as early as 1949. This relationship is known as the Verdoorn Law in recognition of P.J. Verdoorn's early investigations, published in 1949, as highlighted by Kaldor (1966). In his work Kaldor (1966) also argues that the existence of positive relationship between productivity and output growth indicates the existence of increasing returns to scale at the industry level.

Nevertheless, the novelty of Hall's work rests on two factors. The first is the methodology that he used to exploit the observed positive relationship between productivity shocks and output growth in order to test the hypothesis of equality of prices and marginal costs in the US industries. The method of estimating the ratios of price over marginal cost in the US industries presented in Hall's paper avoids many of the problems encountered in estimating markup over marginal cost of previous studies which basically relied on the census of price-cost margins and calculated with respect to average variable costs (e.g. Bloch, 1992 and 1994).

The second factor is his formal economic explanation, in terms of market power and increasing returns to scale, for his findings of positive correlation between productivity shocks and output growth. This is in contrast to other economic explanations such as labour hoarding, real business cycle theory, measurement errors in labour productivity, and the possibility of external economies at the industry level.

The aim of this paper is two fold. First, it investigates whether the procyclical movements in total productivity in Australian manufacturing industries provide some evidence for a particular type of market structure, following the work of Hall (1986 and 1988), DHP (1988), Norrbin (1993) and Basu and Fernald (1997). Second, it presents a formal explanation for the observed difference in estimated markup ratios and returns to scale by using gross output and value added data. The formal explanation presented in this paper shows that the estimated Solow residual and hence the markup ratios with the use of value added data are almost twice as large as that of gross output data, because of the use of two different production functions in estimating the Solow residual.

In this paper, we regress the 'Solow residual' on value added data as well as gross output data, by using the aggregate demand and the relative price of imports as instrumental variables and calculate the markup ratios for eighteen (three-digit) Australian manufacturing industries, for the sample period 1968 to 1984. The main results of the paper, based on the value added data, indicate that the prices of most Australian manufacturing industries exceed their marginal costs, as in the case of US industries, confirming the Hall's hypothesis. The highest markup ratios are reported by the chemical and the iron and steel industries. The results also indicate that the textile, non-mineral products, other transport and photographic and scientific industries behave as competitive industries. On the other hand, although the estimated markup ratios based on the gross output data are lower than the calculated markup ratios based on value added data, those results also indicate that the prices of wood and wood products, paper and printing, clay products, iron and steel, plastic products and other manufacturing industries exceed their marginal costs.

In section 2 of the paper, we reproduce a slightly modified version of the methodology that Hall (1988) developed to estimate price over marginal cost (markup) ratios in the US industries. A brief discussion of the results of DHP (1988), Norrbin (1993) and Basu and Fernald (1997), and a formal explanation for the observed difference in estimated markup ratios by using gross output rather than value added data is given in section 3 of the paper. Section 4 presents the empirical results for 18 manufacturing industries in Australia. Some concluding remarks are presented in section 5.

2. Methodology

The methodology of Hall is based on the work of Robert Solow (1957). Consider the following neo-classical production function with constant returns to scale and Hicks-neutral technology.

$$Y_t = A_t f(K_t, N_t, M_t) \tag{1}$$

where Y_t, denotes total output and K_t, N_t, M_t are measures of three inputs (factors) used in the production process, capital, labour, and raw materials, respectively. A_t reflects technology, with movements in A_t indicating movements in total factor productivity, i.e. variations of output independent of variation in inputs through disembodied technological change. We assume that f is homogenous of degree one, indicating constant returns to scale production technology.

Totally differentiating (1) with respect to time and dividing by Y, we obtain

$$\frac{dY}{Y} = \Theta + S_k \frac{dK}{K} + S_n \frac{dN}{N} + S_m \frac{dM}{M} \tag{2}$$

where $\Theta = \frac{dA}{A}$, $S_k = A\frac{\partial f}{\partial K}\frac{K}{Y}$, $S_n = A\frac{\partial f}{\partial N}\frac{N}{Y}$ and $S_m = A\frac{\partial f}{\partial M}\frac{M}{Y}$.

Under the assumption of perfect competition, since all factors are paid according to their marginal products, S_k, S_n and S_m are the shares of capital, labour and raw material incomes in the value of output. Moreover, S_k, S_n and S_m also measure the elasticities of the production function, and under constant returns to scale, that we have $S_k + S_n + S_m = 1$, and $S_k = (1 - S_n - S_m)$. Thus, slightly re-arranging equation (2), we can rewrite it as

$$\frac{dY}{Y} - \frac{dK}{K} - S_n\left(\frac{dN}{N} - \frac{dK}{K}\right) - S_m\left(\frac{dM}{M} - \frac{dK}{K}\right) = \Theta \tag{3}$$

The main findings of Solow's work which is subsequently well known among economists as the 'Solow residual' is shown in equation (3). Solow (1957) argues that with constant returns to scale (CRTS) and perfect competition the percentage change in A_t can be measured from observed data. Under (CRTS), total output and total factor input grow at a common rate unless there is a change in technology. Thus, under CRTS and perfect competition, if a common exogenous variable (e.g. aggregate demand) is driving both output and inputs but not the state of technology, then measured productivity growth should not be correlated with changes in the exogenous variable. *In other words, under the two conditions of CRTS and perfect competition, the measured percentage change in total productivity does not vary with the rate of changes in output or inputs.* This is the point that Hall exploits in order to develop the originality of his work presented in his series of papers (1986, 1988, 1990). Thus, he postulates that if there is any exogenous variable (say, aggregate demand) which affects the level of output, the levels of employment and of capital as well as the level of raw material used in production, it should not have a positive correlation with the measured value of productivity changes under the assumption of constant returns and perfect competition.

Under perfect competition, since price is equal to marginal cost (MC), using equation (3) it can be shown that

$$MC = \frac{P}{\mu} = \frac{W\,dN + R\,dM + r\,dK}{dY - \Theta Y} \qquad (4)$$

where W is the price of labour, R is the price of raw materials, $r = \{(PY - WN - RM) / K\}$, is the rental price of capital and μ is the markup ratio $(\frac{P}{MC})$.

Using (4) and following Hall, we can incorporate the markup ratio (μ) into equation (3) in order to show that marginal cost can be calculated from the observed data.

$$\frac{dY}{Y} - \Theta = \mu \frac{WN}{PY}\left(\frac{dN}{N} - \frac{dK}{K}\right) + \mu \frac{RM}{PY}\left(\frac{dM}{M} - \frac{dK}{K}\right) + \frac{dK}{K} \qquad (5)$$

In logarithmic form, equation (5) can be written, as

$$\Delta y_t - \mu\, S_n \Delta n_t - \mu\, S_m \Delta m_t = \theta + u_t \qquad (6)$$

where Δy_t = rate of growth of output /capital ratio [$\Delta \log(Y/K)$]

Δn_t = rate of growth of labour/capital ratio [$\Delta \log(N/K)$]

Δm_t = rate of growth of raw material/capital ratio [$\Delta \log(M/K)$]

θ = rate of Hicks-neutral technical progress [$\Delta \log \Theta$]

u_t = random term.

It is assumed that u_t is uncorrelated with the fluctuation of output growth. Equation (6) is the fundamental equation of Hall (1988).

Following Hall, suppose that there is an exogenous variable, say aggregate demand or government expenditure, v_t, which affects the level of output, employment , and raw materials, but is not correlated with the random element of productivity growth, u_t. Then the value of μ (markup) is equal to unity. On the other hand, when the exogenous variable is found to be positively correlated with the Solow residual, then, $\mu > 1$, and it refutes the joint hypothesis of perfect competition and constant returns. Thus, Hall argues that any observed positive correlation of an exogenous variable, v_t, with output and employment as well as the Solow residual is most likely an indication of market power and increasing returns to scale. 'Conditions of competition with constant or decreasing returns to scale are incompatible with a positive correlation of the residual and the instrument' (Hall, 1988, page 924).

Following DHP (1988), equation (6) can be rewritten as

$$\theta = \Delta y_t - (1-\beta)^{-1} S_n \Delta n_t - (1-\beta)^{-1} S_m \Delta m_t - u_t \tag{7}$$

where $(1-\beta)^{-1}$ is the ratio of price to marginal cost and β is the Lerner index; that is, $(P - MC)/P$.

Re-arranging equation (7), we obtain the following relationship that can be used for estimation purposes:

$$\Delta y_t - S_n \Delta n_t - S_m \Delta m_t = \beta \Delta y_t + (1-\beta)(\theta + u_t) \tag{8}$$

According to equation (8), if the true productivity shock, θ is uncorrelated with any exogenous variable, v_t, the procyclical movements in the Solow residual are generated when $\beta > 0$, indicating the presence of market power where price exceeds marginal cost. On the other hand, when $\beta = 0$, the productivity shock is correlated with the exogenous variable indicating the presence of perfect competition where price equals marginal cost.

If we set the term $S_m \Delta m_t = 0$, the equation that Hall (1988) has used to estimate the markup ratios for US industries is similar to equation (8). The instrumental variables that he used to test his hypothesis are the rate of increase in the world price of crude petroleum, the rate of growth of military expenditure and a dummy variable in order to capture the political changes in the USA. In his estimations, he found that prices in most of the industries exceed their marginal costs.

3. A Formal Explanation for Different Results

The work of DHP (1988), Norrbin (1993) and Basu and Fernald (1997) reveal that Hall's estimated values of markup ratios suffer aggregation bias due to the use of value added data instead of gross output data. According to them, there are mainly two problems associated with the use of value added data in order to estimate the Solow residual for the US industries. First, value added data for the US industries are subject to the measurement errors. Second, value added data do not take into account the importance of raw material inputs in the estimation of the Solow residual.

Although the estimated markup ratios for the US industries by DHP are lower than those of Hall, their results confirm his findings. Nevertheless the results of Norrbin and Basu and Fernald do not support the findings of Hall and DHP. According to Norrbin and Basu and Fernald, the US industries behave as competitive industries rather than non-competitive industries and typical industry has roughly constant returns to scale.

In this section we present a formal explanation for the observed difference of the estimated the Solow residual by using value added data and gross output data and, argue that the difference emerge from the use of two different production functions, namely gross output function and value added function, in estimating the Solow residual. Thus, as we can see below, the estimated Solow residual and hence the markup ratios by using gross output data are almost twice as small as the markup ratios estimated by using value added data[2].

In order to show the relationship between the Solow residual estimated from gross output functions and value added functions, consider the definition of output as measured by value added:

$$V = PY - RM \tag{9}$$

where V is the nominal value added and P is the price of output.

Totally differentiating (9) and dividing by V, we obtain

$$\frac{dV}{V} = \frac{PY}{V}\left(\frac{dP}{P} + \frac{dY}{Y}\right) - \frac{RM}{V}\left(\frac{dR}{R} + \frac{dM}{M}\right) \tag{10}$$

In order to estimate the Solow residual from the value added function we have to obtain the real value added from nominal value added by removing price effects from (10):

$$\frac{dV^*}{V^*} = \frac{dV}{V} - \frac{PY}{V}\frac{dP}{P} - \frac{RM}{V}\frac{dR}{R} \tag{11}$$

Thus we have

$$\frac{dV^*}{V^*} = \frac{PY}{V}\frac{dY}{Y} - \frac{RM}{V}\frac{dM}{M} \tag{12}$$

Substituting (2) into (12) we obtain

$$\frac{dV^*}{V^*} = \frac{PY}{V}\left(\Theta + S_k\frac{dK}{K} + S_n\frac{dN}{N} + S_m\frac{dM}{M}\right) - \frac{RM}{V}\frac{dM}{M} \tag{13}$$

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[2] I am indebted to Peter Dixon and Jay Menon for highlighting this point to me.

By cancellation of the last two term of (13) it can be rewritten as

$$\frac{PY}{V}\Theta = \frac{dV^*}{V^*} - \frac{rK}{V}\frac{dK}{K} - \frac{WN}{V}\frac{dN}{N},$$

which could be interpreted as the Solow residual obtained from the value added function. That shows that the estimated Solow residual by using value added function is larger by the ratio of $\frac{PY}{V}$ than the estimated Solow residual by using gross output function. Empirical evidence shows that the ratio of $\frac{PY}{V}$ is almost equal to two for most of the industries. That implies the Lerner indexes estimated by using value added data are almost twice as large as those estimated by using gross output data, and that markups will appear to be larger than in the case where the gross output data are used [3].

4. Estimation of Markup ratios for Australian Manufacturing Industries

In order to estimate the markup ratios for Australian manufacturing industries, we regress the Solow residual given in equations (8) and (9) on Δy_t. In our estimations, we use both gross output data and value added data, separately, in order to highlight our argument that the estimated markup ratios by using gross output function are almost twice as small as those estimated by using value added function. To overcome the simultaneity problem associated with the use of Δy, we use the instrumental variables procedure followed by Hall (1988), DHP (1988) and Norrbin (1993).

Under the assumptions that no individual industry is large relative to the economy and that there is no common element to productivity disturbances across industries, we use aggregate demand variable, namely , current and a lagged GDP growth, as our instrumental variable. In addition, we also have used the relative price of imports as an alternative.

4.1 Data

The estimations cover the period 1968 to 1984 using panel data based on three-digit manufacturing surveys published by the Australian Bureau of Statistics. To measure output (Y) we use gross output data as well as value added data in two separate estimations. These data, together with the total wage bill and the cost of raw materials used in production enable us to estimate factor shares for each manufacturing industry. A price index for each industry and an industry specific relative price index for imports are taken from the data supplied by Harry Bloch (1994) as used in his work. Capital stock data are obtained from Ralph Lattimore (1989).

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3 The truth of the last assertion is apparent if one imagines replacing the left-hand variable in (8) with one that everywhere half as big. Then consistent estimation of (8) should lead to a value of β which is twice as large.

4.2 The Results

Results presented in Table 1, are based on the value added data for eighteen three-digit (ASIC) Australian manufacturing industries. Column 2 of the table gives estimated values of Lerner indices (β) by using current and lagged values of aggregate demand, as instrumental variables. Column 6 of the table shows estimated values of Lerner indices (β) by using current and a lagged values relative price of imports, as instrumental variables. The markup ratios for each industry are calculated as $1/(1-\beta)$, and are given in columns 1 and 5 of the table. The t-value in column 2 of the table shows that estimated β values (Lerner indices) of fourteen manufacturing industries are significantly different from zero at the 5% level, indicating that the price of those industries substantially exceeds their marginal costs. The highest markup ratios are reported in chemical (12.43) and iron & steel (6.06) industries. The lowest markup ratio is reported in electrical equipment (1.95). The rest of the fourteen manufacturing industries have markup ratios ranging from 2 to 4. The estimated β values of four manufacturing industries (textile, non metallic minerals, other transport, and photographic & scientific industries), are not significantly different from zero, supporting the conclusion that those industries are competitive.

When instrumentation is changed from aggregate demand to the relative price of imports, however, this picture changes considerably. Column 6 of the table shows only half of the eighteen industries with the estimated β values significantly different from zero at 5% level. Among them the chemical industry has the highest markup ratio of 30.49 while that of the paper and paper products industry is estimated to be 4.14. The other industries which have markup ratios greater than one are wood and wood products (2.73), clay products (3.36), cement (1.96), electrical equipment (2.06), rubber products (1.90), plastic products (2.252) and other manufacturing (1.88). On the other hand, the estimated * values of the rest of the eighteen industries (textile, clothing, footwear, non-metallic mineral, iron & steel, motor vehicles, other transport, photographic & scientific equipment and leather products) do not differ from zero at 5% level, supporting a competitive industry structure. Among those industries textiles, clothing, footwear, motor vehicles, other transport, photographic & scientific equipment and leather products industries could be classified as import competing industries although during our sample period they were protected with tariff barriers.

Table 1: Estimated markup ratios for Australian manufacturing industries based on value added data

Industry	$\mu^{(1)}$	$\beta^{(1)}$	Ad R^2	DW	$\mu^{(2)}$	$\beta^{(2)}$	Ad R^2	DW
Textile	1.569	0.362 (0.598)	0.537	1.857	–1.07	1.931 (1.632)	0.537	2.722
Clothing	3.309	0.697 (4.687)	0.749	1.361	1.28	0.216 (0.580)	0.749	1.062
Footwear	2.375	0.579 (2.678)	0.561	1.333	1.55	0.356 (0.377)	0.561	1.237
Wood	3.731	0.732 (5.358)	0.762	0.634	2.726	0.633 (3.595)	0.762	0.615
Paper	4.032	0.752 (4.369)	0.816	1.846	4.139	0.7584 (4.554)	0.815	1.842
Chemicals	12.426	0.919 (12.055)	0.967	2.139	30.49	0.964 (6.609)	0.967	2.208
Clay products	4.464	0.776 (9.187)	0.947	1.823	3.156	0.683 (11.357)	0.947	1.702
Cement	3.185	0.686 (6.456)	0.846	2.159	1.956	0.489 (4.186)	0.846	2.294
NM Minerals	1.610	0.379 (0.997)	0.936	1.523	1.98	0.495 (1.787)	0.936	2.117
Iron & Steel	6.061	0.835 (9.529)	0.909	1.223	1.157	0.136 (0.140)	0.909	2.788
Motor Vehicles	3.115	0.679 (5.152)	0.877	2.512	1.738	0.424 (1.615)	0.877	2.115
Other transport	–1.04	1.956 (0.55)	0.646	1.854	7.924	0.874 (1.767)	0.646	0.552
Photo & Scientific	1.334	0.251 (0.237)	0.844	1.028	17.212	0.942 (1.601)	0.843	2.001
Electrical equip	1.957	0.489 (3.439)	0.836	2.623	2.058	0.512 (3.673)	0.835	2.625
Leather products	3.546	0.718 (2.103)	0.746	1.397	1.612	0.379 (1.274)	0.745	2.176
Rubber products	2.315	0.568 (8.49)	0.898	2.418	1.897	0.470 (3.866)	0.898	2.327
Plastic products	2.809	0.644 (5.686)	0.866	1.931	2.252	0.556 (5.475)	0.865	2.094
Other Manufacturing	2.915	0.657 (5.561)	0.836	1.292	1.879	0.468 (3.279)	0.835	2.398

Notes: t values are given in the parenthesis; (μ) Markup ratio (P/MC);

(1) Instrumental variables are GDP and GDP_(1);

(2) Instrumental variables are current and lagged value of relative price of imports .

Table 2 presents the estimated mark-up ratios for **Australian manufacturing industries** by using gross output data. Confirming our argument, table 2 shows that the estimated markup ratios are almost twice smaller than those markup ratios presented in table 1, which is based on value added data.

Nevertheless, as shown in column 2 of table 2, the estimated values of Lerner indices of seven out of eighteen industries are significantly different from zero at 5% level, reflecting that the prices of those industries exceeds their marginal costs. Those industries are wood and wood products, paper, chemicals, clay products, cement, iron & steel, plastic products and other manufacturing. The highest markup ratios are reported by paper (6.75) and chemical (4.42) industries. In overall, all seven industries have lower markup ratios ranging from 1.66 to 6.75 compared with the mark-up ratios of fourteen industries estimated by using value added data, and reported in table 1, which ranging from 1.95 to 12.42.

The estimated β values of eleven manufacturing industries (textile, clothing, non metallic minerals, other transport, and photographic & scientific industries, electric equipment, leather products, rubber products), are not significantly different from zero and indicate that those industries are competitive.

Nevertheless, column 6 of the table shows that only four of the eighteen industries have the estimated (by using relative price of imports as instrumental variable) β values significantly different from zero at 5% level, indicating that they are non-competitive industries. Among them the chemical industries have reported the highest markup ratio of 9.17 and the lowest mark-up ratio is reported by motor vehicles industries (1.40). The other industries which have markup ratio greater than one are clay & clay products (2.61), and cement (1.41), industries. On the other hand, the estimated β values of the rest of the eighteen industries (textile, clothing, wood, paper non-metallic mineral, iron & steel, other transport, photographic & scientific equipment, electric equipment, leather products, rubber products, plastic products and other manufacturing), are not significantly different from zero at 5% level and indicate that they are competitive. Most of these industries could be classified as import competing industries although during our sample period (1968-1984) they were protected with tariffs.

Table 2: Estimated markups for Australian manufacturing industries based on gross output data

Industry	μ(1)	β(1)	adj R^2	DW	μ(1)	β(2)	adj R^2	DW
Textile	2.36	0.576 (0.452)	-0.064	1.712	1.13	0.116 (0.484)	-0.064	1.743
Clothing	1.12	0.110 (0.699)	-0.052	1.054	0.99	-0.012 (-0.089)	-0.052	0.744
Wood	1.68	0.405 (2.344)	0.232	1.720	1.31	0.236 (1.279)	0.232	1.617
Paper	6.75	0.852 (2.575)	0.359	2.106	4.17)	0.760 (1.561)	0.359	2.041
Chemicals	4.42	0.774 (1.699)	0.200	1.981	9.17	0.891 (2.476)	0.200	2.047
Clay products	2.15	0.535 (4.112)	0.639	0.839	2.61	0.617 (3.279)	0.639	0.886
Cement	2.48	0.597 (3.869)	0.581	1.740	1.41	0.293 (2.182)	0.581	0.983
NM Minerals	1.37	0.272 (0.925)	0.824	1.473	0.93	-0.075 (-0.073)	0.824	1.342
Iron & Steel	2.14	0.533 (2.844)	0.319	1.321	1.18	0.150 (0.319)	0.319	1.646
Motor Vehicles	1.96	0.491 (1.863)	0.443	2.235	1.40	0.287 (3.005)	0.443	2.029
Other transport	1.32	0.242 (0.505)	0.001	1.682	2.69	0.629 (0.443)	0.001	2.407
Photo & Scientific	1.44	0.306 (1.290)	0.351	1.425	1.57	0.363 (1.406)	0.351	1.503
Electrical equip	1.18	0.156 (0.647)	-0.071	1.670	1.10	0.091 (0.450)	-0.071	1.792
Leather products	1.82	0.451 (0.369)	0.081	1.990	0.97	-0.028 (-0.078)	0.081	2.358
Rubber products	1.62	0.384 (1.896)	0.090	1.085	1.38	0.276 (1.606)	0.090	1.075
Plastic products	1.89	0.473 (2.062)	0.304	1.108	1.46	0.316 (1.277)	0.304	1.086
Other Manufact	1.66	0.396 (2.056)	0.135	1.678	0.95	-0.053 (-0.221)	0.135	1.791

Notes: t values are given in the parenthesis; (μ) Markup ratios (MC/P);

(1) Instrumental variables are GDP and GDP_(1);

(2) Instrumental variables are current and lagged values of relative price of imports.

Table 3: Comparison of estimated markup ratios for the Australian and the U.S. manufacturing industries

Industry	$\mu^{(1)(*)}$	Hall (1990)(2)	$\mu^{(1)(**)}$	DHP (1988)(3)	Norrbin (1993)(4)
Textile	1.569	2.578	2.36	1.262	1.277
Clothing	3.309	0.824	1.12	1.54	0.785
Footwear	2.375	–	NR	–	–
Wood	3.731	1.801	1.68	1.40	0.705
Paper	4.032	3.716	6.75	1.56	0.930
Chemicals	12.426	20.112	4.42	1.61	11.252
Clay Minerals	4.464	2.536	2.15	1.74	1.533
Cement	3.185	–	2.48	–	–
NM Minerals	1.610	–	1.37	–	–
Iron & Steel	6.061	2.172	2.14	1.39	1.118
Motor Vehicle	3.115	1.763	1.96	1.41	1.190
Other transport	-1.04	0.950	1.32	–	1.056
Photo & Scien	1.334	1.397	1.44	–	1.472
Electric equip	1.957	3.086	1.18	2.03	1.417
Leather product	3.546	2.100	1.82	1.46	0.688
Rubber product	2.315	1.508	1.62	1.67	1.254
Plastic product	2.809	–	1.89	–	–
Other Manufac.	2.915	4.491	1.66	–	2.053

Notes: (*) Estimates are based on value added data such as in Hall (1988),

(**) Estimations are based on gross output data as in DHP (1988) and Norrbin (1993).

(1) Instrumental variables are GDP and GDP_(1).

(μ) Markup ratio (P/MC).

(2) Hall's sample period 1953-1984.

(3) DHP's sample period 1958-84.

(4) Norrbin's sample period 1949-1979.

Table (3) presents a comparison of our estimated markup ratios for the Australian industries with the estimated markup ratios for the US industries by Hall, DHP, and Norrbin. Except for the findings of the Norrbin's our results shows that estimated markup ratios for **Australian manufacturing industries** are closer to the findings of Hall's and DHP's. For an example, for value added data (column 1) the Australian Chemical industries show higher markup ratios as in the US industries (column 2). Moreover, for the case of gross output data our estimates report a lower markup ratios as in the case of DHP for the U.S. manufacturing industries.

5. Concluding Remarks

There are two aims of this paper. First it investigates whether the procyclical movements in total factor productivity in **Australian manufacturing industries** provide some evidence for a particular type of market structure, following the work of Hall (1986 and 1988), DHP (1988), Norrbin (1993) and Basu and Fernald (1997). Second, it provides a formal explanation for the observed difference between the estimated Solow residuals (and hence the markup ratios) by using value added data and gross output data. The paper argues that the observed difference of the estimated Solow residuals are due to the use of value added function for the value added data and gross output function for the gross output data, in the estimation procedure.

The main results of the paper, based on the value added data, indicate that the price of most of **Australian manufacturing industries** exceeds their marginal costs, during the sample period 1968 to 1984, as in the case of US industries. The highest markup ratios are reported by the chemical industries and iron and steel industries. The results also indicate that the textile, non mineral products, other transport and photographic and scientific industries are competitive. On the other hand, the estimated markup ratios based on the gross output data reveal that they are lower than the estimated markup ratios based on value added data. Nevertheless, those results also indicate that the prices of seven out of seventeen industries (wood and wood products, paper and printing, clay products, iron and steel, plastic products and other manufacturing industries) exceed their marginal costs.

The comparison our estimated markup ratios with the estimated markup ratios of Hall and DHP show that most of **Australian manufacturing industries** behave as non-competitive industries as in the case of the US industries.

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