Pricing-to-market in NSW rice export markets[†]

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The Ricegrowers' Cooperative Limited is a single-desk seller of NSW Japonica rice on the export market. Confidential monthly price data supplied by the Cooperative were used to examine 'pricing-to-market' in four of its major export markets. The hypothesis of a competitive market was rejected. The Cooperative has been able to vary mark-ups over different markets and with respect to the importer's currency in each market. The exchange rate results in particular suggest that the Cooperative has been able to exercise market power to obtain price premiums.

1. Introduction

Although Australia is only a minor participant in total world rice trade, based principally on long grain varieties, it is a major producer and exporter of medium grain or Japonica rice varieties. More than 75 per cent of the rice grown in Australia is Japonica, and in recent years Australia's share of this varietal trade has been around 40 per cent, about the same as the share of the United States. This share is much higher in the major import markets in the Asia-Pacific region (NSW Government Review Group 1996).

Almost all Australian rice is grown in NSW. The NSW Rice Marketing Board vests the NSW rice crop but has had a contractual agreement with the Ricegrowers' Cooperative Limited since 1985 whereby the Cooperative is the sole miller and marketer of NSW rice. The industry is therefore able to operate as a single-desk seller on the export market under the auspices of the legislation establishing the Board. Whether that ability should be retained was one of the issues of the recent legislative review of the NSW rice industry conducted as part of the implementation of National Competition Policy.

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The industry argued that it should retain its single-desk selling status because, given its prominent position in the Japonica market, it could better investigate, develop and maintain markets and provide enhanced returns to growers by practising 'price discrimination' or 'pricing-to-market'. Effective price discrimination results in higher overall industry revenue compared to a situation where all sales are made at the same price. On the other hand, it has been argued by several commentators that any price premium obtained from export markets is more likely to reflect product attributes other than market power (Industries Assistance Commission 1987; Industry Commission 1991; Kraft *et al.* 1991).

Yumkella *et al.* (1994) used a pricing-to-market model to examine the competitiveness of US and Thai long grain rice exports to eight different markets over the period 1980–87. They found evidence to reject hypotheses of competitive pricing by each supplier and some evidence of imperfect exchange rate pass-through in several markets. In concluding, they suggested that market power may be able to be exerted in the medium grain rice market as well.

Using a similar analytical framework, the aim of this study was to examine evidence from past sales data that the NSW medium grain rice industry has the potential ability to price-to-market. Such ability, however, does not necessarily ensure that there will be net gains to growers or to society. Gains to growers may not materialise because of the extra costs incurred in achieving those gains or because of imperfections in price transmission which mean that gains are not passed onto growers.

2. Analytical framework

2.1 Theory

In a competitive market, price is determined by the intersection of aggregate supply and aggregate demand, and the same price is charged to different customers after accounting for transport, storage and other transformation services and costs. To the individual firm, price equals marginal revenue equals marginal cost, and nothing the firm does can influence the price it receives for its product. The firm is a 'price taker'. However, in an imperfect market characterised by price discrimination, the firm is large enough to exert some market power, and different prices may be charged to customers with different demand characteristics, after accounting for the costs of transformation, so as to increase total revenue.

There are two critical assumptions underlying the ability to price discriminate across markets. First, the markets must be separated in space, time, form or some other dimension, and this separation must be maintained

so that there is no possibility for arbitrage. Second, the response of demand to price changes must differ between markets so that the link between prices and marginal revenues varies in the different markets. In the rice export trade, these assumptions may well be met. The major export markets for NSW Japonica rice are separated by long distances, and these markets are likely to have different price elasticities of demand for rice because of their different socio-economic and cultural characteristics.

So, if a central selling agency has market power, then it may be able to achieve price premiums in some markets, sufficient to increase overall returns to the industry, by restricting supplies so that marginal revenues are equated across markets as well as with the marginal cost of production. Because the demand relations vary in the different markets, equating marginal revenues means that prices are higher in markets with relatively inelastic demands, and lower in markets with relatively elastic demands.

Apart from variations in transport costs, prices may well differ across markets for other reasons such as differences in quality, other services bundled with the product such as credit or quality assurance, or supply assurance at particular times of the year. Therefore, when attempting to measure the extent of market premiums, the product being compared should be as similarly defined as possible in each of the markets studied (see Brooks 1993, p. 281). Prices received in the different export markets also need to be converted to a common currency and to a common pricing basis such as FOB. Once the product is so defined, then tests can be done for the existence of significant price differences between markets.

Following Krugman (1987) and Knetter (1989, 1993) among others, the relationship between export returns and exchange rate movements also has been found to be important in analyses of imperfectly competitive trade behaviour. 'The simple integrated, competitive market model predicts that local currency prices should change in proportion to the nominal (bilateral) exchange rate for a country too small to influence world prices' (Knetter 1989, p. 198). Thus, when these local currency prices are converted back to a common currency, there should be no change in price received by the exporter due to any change in the exchange rate. This effect is known as 'complete pass-through'.

In markets where exporters are capable of price discrimination across markets, changes in local currency prices may not fully reflect exchange rate fluctuations. 'Incomplete pass-through' usually occurs if the demand elasticity facing exporters varies with the price of the product in local currency terms. In this case, an exchange rate change will induce a new optimal price to be charged in the local market because of the link between elasticities and marginal revenues. So in testing for price discrimination, it is also important to test whether changes in export prices in different markets fully reflect changes in the relevant exchange rates.

2.2 Model specification and testing procedures

Based on Knetter (1989), the following model was used to test pricing-to-market by the Ricegrowers' Cooperative Limited (as agent of the Board):[1]

$$\ln P_{it} = c + \Sigma \alpha_i D_i + \Sigma \gamma_t T_t + \Sigma \delta_t SD_t + \Sigma \beta_i \ln X_{it} + u_{it} \tag{1}$$

where:

$\ln P_{it}$ = log of the export price of NSW Japonica rice to country i at time t in Australian dollars net of transport costs

D_i = dummy variables to capture the country effect

T_t = annual dummy variables to capture the common time effect

SD_t = monthly dummy variables to capture the common seasonal effect

$\ln X_{it}$ = log of the exchange rate between country i and Australia at time t

c = constant term for the base country, month and time period

u_{it} = error term

The α_i coefficients measure the country effect, the γ_t coefficients measure the common time effect, the δ_t coefficients measure the common seasonal effect and the β_i coefficients measure the exchange rate effect. The data were organised so that, for each observation on price, there was only one country dummy and exchange rate variable. Thus, other country dummy variables and other exchange rates do not influence country i price observations. Models such as these have been used in other reviews of single-desk selling arrangements such as for barley in Canada (Carter 1993) and in Australia (MacAulay and Richards 1997). The model has also been used in more general studies of export competitiveness such as those by Pick and Park (1991) in the wheat, corn, cotton, soybean, and soybean products markets, Park and Pick (1996) in the wheat market, and as noted above, Yumkella *et al.* (1994) in the long grain rice market.[2]

   These sorts of models fall under the general form of panel data models where the data have both cross-section and time series components. Here, the data were unbalanced (different number of observations for different countries). Regression models were run on the whole data set under various assumptions as to whether the intercepts and/or slope coefficients varied

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[1] The Knetter model is specified for a profit-maximising firm and the question arises as to whether such a formulation would be applicable for a cooperative which may or may not have similar pricing objectives as a profit-maximising firm. In the context of the Australian rice market, the question is moot: all the evidence presented to the Review team indicated that the Cooperative has to behave as a profit-maximising firm to be an effective competitor in the market (NSW Government Review Group 1996).

[2] There is also an extensive related literature on the 'Law of One Price' in international agricultural commodity trade (e.g. Miljkovic 1999).

across the cross-section units (countries), and F and Likelihood Ratio tests were performed on these assumptions. Then, t tests were performed on individual intercepts and/or coefficients to provide evidence on whether significant premiums or discounts applied in particular importing countries.

More formally, the hypothesis was that there is a single competitive market for the exports of Japonica rice from NSW. This implies that after accounting for seasonal effects and price changes through time that are common to all markets, export prices are equal to a common marginal cost across all markets so that all $\alpha = 0$. In addition, if changes in bilateral exchange rates are fully reflected in bilateral export prices, there should be no exchange rate effect, so all $\beta = 0$.

The alternate hypothesis was of an imperfect market implying price discrimination. If some $\alpha \neq 0$ and all $\beta = 0$, this implies that there is a constant elasticity of demand with respect to the importer's currency in each market, but the exporter's mark-up differs between markets. Thus price discrimination can occur and price premiums may be obtainable. If some $\alpha \neq 0$ and some $\beta \neq 0$, this implies that the exporter's mark-up varies across markets because demand elasticities vary with exchange rates (Knetter 1989; Pick and Park 1991). Thus, again, price discrimination is feasible. Note again, however, that evidence of some $\alpha \neq 0$ and/or some $\beta \neq 0$ can only be translated into evidence of the ability to price discriminate if the price series used in the different markets is for similarly defined 'products'. Therefore, a finding that $\alpha = \beta = 0$ is sufficient evidence that the market is competitive but a finding that any of these coefficients is different from zero is only a necessary condition for price discrimination.

3. Data

The Ricegrowers' Cooperative Limited supplied confidential price data for NSW exports of Japonica rice to four major markets (denoted Country A, B, C and D) on a monthly basis from July 1982 to April 1995 (153 observations). Australia's principal buyers of rice up to 1996 had been Papua New Guinea, Hong Kong, New Zealand, Saudi Arabia and other Middle East countries, Fiji, the Solomon Islands and other Pacific countries, Turkey and Spain.[3] In at least some of these markets over this period, the United States was said to have competed 'aggressively' (NSW Government Review Group 1996, p. 16). Although the four selected markets cannot be identified and market share data are restricted for commercial reasons, these four markets were said to account for about one-third of all Japonica exports by

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[3] In recent years Japan has emerged as a major market for NSW rice, but was not so during the period of this study.

the Cooperative over this time period. All prices were supplied on a cif basis ($A/tonne), i.e. those received in the export market, including transport costs. Pack sizes ranged from 20 to 30 kg.

To properly test for pricing-to-market, the data need to be defined as similarly as possible, and this means, at the very least, removing the influence of transport costs. This was done as detailed in the Appendix.

No sales were made in some markets in some months. There were 25 instances of no sales, principally in 1984, or about 4 per cent of all observations. The approach followed was to delete the no-sale observations and use an unbalanced dataset.[4]

Nominal exchange rates for the four markets were obtained from the Reserve Bank of Australia and the International Monetary Fund on a monthly basis from December 1983 to April 1995 (137 observations).[5] Knetter (1989) and Carter (1993, p. 251) indexed the exchange rates by dividing each series through by its first observation, so that the β coefficients could easily be compared across countries. There may also be possible efficiency gains in solving the model. However, if the price series is not indexed as well (and it is not here), the country effect will be combined with the exchange rate effect, and it will be difficult to disentangle their separate influences. This seems a stronger argument, so the exchange rate variables were not indexed here.

To estimate the model, dummy variables for countries, months and years were created in the normal fashion. Here annual time dummies were used even though the price and exchange rate data are monthly. The main argument for this is that because rice is a cereal, the general price level tends to be formed for a season and we are interested in removing this general trend in prices. Monthly seasonal effects are also allowed. Note that the β coefficients can be interpreted as (slope) dummy variables associated with the exchange rates for particular countries because price in any country is a function of its exchange rate with Australia only rather than all exchange rates. Because of singularity problems, the dummy variables for Country A, January and 1995 were omitted from the estimating equation. Results are insensitive to this choice except that the constant term applies specifically to Country A and its currency in January 1995. The α, δ and γ terms are differences in the mark-up or intercept term associated with different

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[4] An alternative approach is to interpolate from 'surrounding' data the likely sale price had a trade occurred. This was done also and the models rerun. Little change was seen in the results (Griffith *et al.* 1996).

[5] Pick and Park (1991) also tested real exchange rates but found that the results were largely the same as for nominal exchange rates.

Table 1 Results of the *F* and LR tests on the coefficients as a group

Country effects		Exchange rate effects		Seasonal effects	
F	LR	*F*	LR	*F*	LR
3.13*	9.60*	4.03*	16.34*	0.65	7.39

Note: *Significantly different from zero at the 5 per cent level.

countries, different months and different years respectively, while the β terms represent the mark-up associated with currency changes in particular countries over time.

4. Results

The model specified and described in equation (1) was estimated by ordinary least squares. Initial runs resulted in substantial auto-correlation problems, so the models were rerun with an auto-correlation correction imposed. In all cases, the *t* statistic on the estimated auto-correlation coefficient was significant and the correction was retained. After allowing for the deletion of no-sales and the effect of the auto-correlation correction, there was a maximum of 515 observations on the explanatory variables of interest.

In table 1, *F* and Likelihood Ratio (LR) test values are provided for the hypotheses that the country effects as a group should be omitted, that the exchange rate variables as a group should be omitted and that the seasonal effects as a group should be omitted. The critical *F* values are 2.60, 2.37 and 1.79 respectively, while the critical χ^2 values for the LR test are 7.81, 9.48 and 19.68 respectively. The results indicate that the group of seasonal dummy variables do not significantly add to the explanatory power of the model and should be excluded. The model was re-estimated without these variables. Both the group of country dummy variables and the group of exchange rate variables do significantly add to the explanatory power of the model and should be included in the estimated equation.[6] Thus with all $\alpha \neq 0$ as a group and all $\beta \neq 0$ as a group, this implies that some demand elasticities vary with respect to the importer's currency in these markets, and that mark-ups by the Ricegrowers' Cooperative Limited differ between markets.

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[6] The results were checked by also estimating the model as a pooled cross-section time series model applying the PANEL command in TSP. The conclusions from table 1 were confirmed in every case.

Table 2 Results of the *t* tests on the individual coefficients

Variable	*DB*	*DC*	*DD*	ln *XA*	ln *XB*	ln *XC*	ln *XD*
Coefft.	−0.647	−0.607	−0.251	−0.407	0.270	−0.234	0.188
t-value	(−2.33)*	(−2.09)*	(−0.61)	(−2.57)*	(1.97)*	(−1.50)	(1.23)

Notes: * Significantly different from zero at the 5 per cent level.
The summary statistics were $R^2 = 0.68$; $DW = 2.20$; $\rho = 0.48$ ($t = 12.09$); $n = 515$.

The summary results of the *t* tests on individual country dummy variables and exchange rate variables are reported in table 2. The time dummy variables are not reported, but, as expected, almost all are negative and significant, reflecting the increasing price of rice over the observation period that was evident from the data. In this table, the estimated coefficients are given for the three country dummies and the four exchange rate variables, together with the calculated *t*-test statistics. Two of the country dummy variables (Country B and Country C) and two of the exchange rate variables (Country A and Country B) were significantly different from zero at the 5 per cent level. Therefore, with some $\alpha \neq 0$ and some $\beta \neq 0$, some demand elasticities vary with respect to the importer's currency in these markets, and some mark-ups are different between markets.

Based on the results in table 2, an estimate was made of the price differentials applying in the different markets by substituting in mean values of the explanatory variables. These differentials are reported in table 3.[7] Excluding the calculations for Country D where the estimated coefficients have substantial errors, the estimates imply price differentials from the base country of between 17 and 25 per cent over the complete sample period. Some calculations for individual years suggest substantial variation in differentials from year to year, and some large differences between actual and predicted differentials, implying other influences on prices in specific markets beside those picked up in the estimated equation. On average, though, these estimates suggest a gross premium from these selected markets of around $8m per year, which can be compared with a figure of around

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[7] The estimated premiums for Countries B, C and D relative to Country A may seem inconsistent with the negative coefficients on the country dummy variables reported in table 2. Several factors are at work here. The premiums are the joint outcome of the country dummy variables and the exchange rate effects as well as the common negative time effects. Since the data are in logs, some of the exchange rate means are positive and some are negative, but when multiplied by their estimated coefficients, all have a negative impact. The net effects are different deductions from the constant term for the different countries, which when converted to antilogs gives different positive premiums, compared to Country A.

Table 3 Actual and estimated price differentials, average 1984–1995, $/tonne FOB

Item	Country A	Country B	Country C	Country D
Actual means	433.7	480.5	511.2	498.7
Actual differentials from Country A	–	46.8	77.5	65.0
Estimated means	434.3	481.4	510.3	499.1
Estimated differentials from Country A	–	47.1	76.0	64.8

$30m per year for all markets calculated in research undertaken for the Board (NSW Government Review Group 1996, p. 23).

5. Conclusion

In this study, confidential monthly price data from the Ricegrowers' Cooperative Limited and published exchange rate data have been used to examine 'pricing-to-market' in four major export markets for NSW Japonica rice which account for about one-third of all Australian rice exports.

The hypothesis of competitive prices, that is equivalent FOB prices to the different markets, was soundly rejected. In the aggregate tests (table 1), the model with both intercepts and slopes varying across countries was preferred over both the model with constant slopes and constant intercepts over all countries and the model with constant slopes and intercepts varying across countries. Thus, there have been significant differences across countries in both the level of prices and in the response of prices in those countries to exchange rate changes. In the individual coefficient results (table 2), two of the country dummy variables and two of the exchange rate variables were significantly different from zero at the 5 per cent level. Based on these results, the implication is that the Ricegrowers' Cooperative Limited has been able to vary mark-up charges over different markets (the country effect) and that demand elasticities vary with respect to the importer's currency in each market (the exchange rate effect).

While there is compelling evidence to suggest that the Ricegrowers' Cooperative Limited was able to vary the mark-up it charged in at least two different markets (the significant country effects), from the information received we do not know what other market services were bundled with the rice shipped into these markets. The Industries Assistance Commission (1987, p. 13) pointed out that 'The Cooperative adopts the same "niche" marketing approach in the export market [as in the domestic market]. It endeavours to obtain a price premium for quality packaging, strict quality control,

established brand names, and reliable storage and distribution arrangements.'
Some of the market services embodied in these prices are market intelligence,
advertising, promotional visits, provision of credit, quality assurance, pest
and disease assurance, continuity of supply, warehousing and local market
transportation, etc. Similar comments have been made by other
commentators (Industry Commission 1991; Kraft *et al.* 1991). To what extent,
if any, the significant premiums measured in these markets are due to
differences in the marketing services provided by the Cooperative in these
markets cannot be deduced from this type of analysis. The above results
relating to the significant country effects are a necessary condition, but not a
sufficient condition, towards reaching a conclusion as to whether the
Cooperative has market power. Further, the fact that there is another major
exporter with about the same market share as the Cooperative suggests that
any market power premiums would be quickly bid away. Thus, the measured
country price differentials reported above are more likely to be what are now
known as 'competitive price premiums' (Meyer Strategy Group 1996).

However, from the exchange rate results, the significant coefficients on
two of the countries are inconsistent with a hypothesis of competition or a
hypothesis of price discrimination with constant elasticity of demand
(Knetter 1989, p. 201). Price discrimination across variable elasticity demand
curves is favoured. Given this result, and the evidence that mark-ups between
markets are different, on balance, a conclusion can be drawn that the
hypothesis of a single competitive market for exports of Japonica rice from
NSW is rejected, and that the alternative of an imperfect market implying
price discrimination is plausible. The Cooperative therefore is likely to have
had market power and been able to exercise this to obtain price premiums
from some regular markets into which it sells.

One explanation for this result may involve consideration of the relative
variability of exchange rates compared to freight rates and prices in export
markets. The latter to some extent are negotiated well in advance as part of
the overall contract to supply to specific markets, while the former vary over
very short time frames. Thus, there are likely to be high transactions costs
in changing prices, the more so the more market services are bundled with
the rice. Some sort of partial adjustment to exchange rate changes would be
expected (much the same as vehicle importers use to deal with changes in
the value of the yen). The persistence of the exchange rate effects over the
whole sample period suggests that the Cooperative may have some power to
do better than just average out gains and losses in foreign currency terms.[8]

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[8] This argument does suggest, however, that the static 'pricing-to-market' model proposed
in equation (1) may need to be refined for future applications to short periodicity data.

It is interesting to come back to the study by Yumkella *et al.* (1994). They rejected the hypotheses of competitive pricing by the United States and Thailand in the long grain rice market and suggested that market power may be able to be exerted in the medium grain rice market as well. Our results suggest that this has indeed occurred. One thing we cannot say, however, is that this is necessarily due to the single-desk status of the Ricegrowers' Cooperative Ltd.

Appendix: calculation of FOB prices

The final set of price data supplied by the Cooperative was on a cif basis, inclusive of transport costs. No organisation was able to provide the cost of transporting rice to each of the four selected markets on a monthly basis over the full time period. However, various shipping companies and freight forwarding agents were able to supply freight cost indexes over part of the required time period and actual freight charges at particular points in time, sometimes for the particular markets being modelled but more usually for broad regional destinations. In addition, the Cooperative was able to supply some freight rate adjustments for some markets. Based on this information, indexes for the particular markets were calculated, taking account of the broad regional indexes, costs for specific periods and advice from the Cooperative that certain discounts were able to be negotiated because they were a regular high volume customer.

These estimated freight costs and consequent FOB prices were validated in two ways. First, the Cooperative was able to provide data on average annual cif, freight and FOB values for shipments to all markets over the full time period. These freight costs reflected the mix of shipments in any one year to all markets, some close and some distant, some large volume and some small volume. However, the orders of magnitude of the estimated costs matched these actual averages quite well. Second, the estimated FOB prices were compared with some subsets of prices provided early in the research process which were FOB. The differences between the original and revised prices were again broadly in line with our estimates of freight costs.

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