# Valuing Australian wheat quality characteristics in selected Asian markets

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*Abstract*

One of the most important factors in determining the demand for wheat is its end use. The suitability of wheat for any end use is determined by the quality characteristics of the grain. Determining the premiums and discounts associated with these characteristics is of value to the grains industry for production, handling and storage, and marketing and trade decisions. In this study, a hedonic price function is applied to Australia's wheat exports to estimate the implicit values of the quality characteristics. The quality characteristics which are analysed are protein, test weight, moisture, amylase activity, and unmillable and foreign material. The paper focuses on Australia's Asian markets, an existing major export region for Australia with potential growth. The values for the quality characteristics in the wheat markets of China, Japan, Indonesia, Malaysia, Singapore, South Korea, and Thailand are estimated. The data sample for the study is from 1984 to 1991. The sample is divided into two separate periods for testing the consistency in demand and determining recent trends in payment for quality. The implications of the results for production, the grading system, breeding programs, handling and storage, and marketing and trade strategies are discussed.

## Introduction

The demand for wheat depends upon many factors the most important of which is its actual end use. The suitability of wheat to any end use is determined by the quality characteristics of the grain. Determining the premiums and discounts associated with these characteristics is of significance to the grains industry for production, handling and storage, marketing and trade decisions. For instance, quality characteristics are the basis of the grading system, are impacted by the storage and transportation of the grain, an integral part of wheat breeding programs and an important aspect upon which marketing strategies are developed. Australian wheat exports have experienced various trends in direction with the most recent being the rise in importance of once minor Asian markets. The Asian markets produce various end uses from Australian wheat and demand various quality attributes of the wheat.

The main objective of this paper is to measure the implicit values for Australian wheat characteristics in the major Asian markets. To that end, an hedonic price function is utilised to test the extent to which various wheat characteristics explain price. The paper is set out in the following manner. Background information on the Asian markets studied is given, followed by outlining the model and data utilised for the analysis. The results are then presented and interpreted. An attempt is made to explore the policy implications for the various participants in the wheat industry before concluding.

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## Background

Australia has always exported significant quantities of wheat to Asian markets, such as Japan and China. However, there has been a rise in exports to the Southeast Asian markets of Indonesia, Malaysia, Singapore, South Korea and Thailand. These five markets accounted for over 25% of Australia's exports in 1991–92 (Australian Wheat Board (AWB) 1992) which is more than double what they accounted for in 1986–87. Asian markets accounted for 44% of Australian wheat exports in 1990–91 and 31% in 1991–92 due to a substantial drop in exports to China in that year (AWB 1992). Unlike the Middle East where most of the wheat has flat bread as its end product, there are various end uses throughout Asia, with the importance of each varying from one country to another. Generally speaking, Australia's wheat exports are used mainly for flat breads (45%), noodles (31%) and pan bread (11%) while steamed bread, chappaties and cakes/biscuits account for 4% each (Wrigley 1994).

In China almost half of all wheat flour is used to produce noodles, with another 30% used for steamed bread and dumplings. Pan bread only represents about 7–8% with the remaining 15% used for cakes and biscuits (Miskelly 1987). All of the quality wheat purchased by China from Australia falls into the Australian Standard White (ASW) category, while there are minor shipments of feed wheat.

Japan's two major end uses are pan bread and noodles, each representing over a third of total wheat usage, while confectionery, industrial and other uses make up the remainder (Miskelly 1987). Around 70% of the Australian wheat purchased by Japan is from the ASW category, while most of the remaining 30% is from the high quality Australian Prime Hard (APH) category.

Noodles are Indonesia's major end product and are estimated to represent up to 70% of total wheat usage, while pan breads represent 15–20% and cakes and biscuits the remaining 10–15% (Miskelly 1987). The major classes of wheat sold to Indonesia are ASW and ASW soft varieties, accounting for nearly 80%, while Australian Hard (AH) and APH make up the remainder.

Noodles are also the major end product of all wheat in Malaysia representing over 40% of flour usage. Pan bread and biscuits represent up to 30 and 25%, respectively, and the remaining flour is used for cakes, pastries and steamed buns (Miskelly 1987). ASW is the major class of wheat sold to Malaysia, representing around 59% of all Australian wheat exports over the previous 7 years. The APH category (24%)

also represents a significant portion with AH (7%), Soft, General Purpose and Feed making up the remainder.

Singapore purchases a wide variety of wheat from Australia including APH, AH and ASW which are used mainly for noodle and bread production. In South Korea, noodles are the major end use with bread and confectionary products also produced in significant quantities (Miskelly 1987). South Korea purchases mainly ASW and Soft wheat from Australia, as well as significant quantities of AH. Thailand usually imports high protein wheats for bread manufacture, although noodles and biscuits are also produced. Thailand imports a wide variety of wheats from Australia including APH and AH, but ASW is the largest grade imported.

Overall, although noodles are the major end product in most Asian markets, there exist many different end uses of wheat in this region. The majority of wheat purchased by Asia comes from the ASW category, while there are also significant quantities of AH and APH in some markets.

The various end uses require different quality wheats. There are many types of noodles which can be grouped into three broad categories: white salted noodles, yellow alkaline noodles and instant noodles (salted or alkaline). White salted noodles require a relatively soft grained white wheat with a protein content of 9–10% while flour colour is also of prime importance. The protein content in yellow alkaline noodles varies from type to type with egg noodles requiring 12%, and Hokkein style 10.5%. Instant noodles are generally made from flour with a protein content of 10.5 to 11%.

In relation to pan bread the quality requirements depend on how leavened the bread is desired. For leavened breads, wheat which is reasonably hard (particle size index 12–19) with a medium to high protein content (11.5–14.5%) is the most desirable. For lightly leavened and unleavened breads, the protein content does not need to be as high, and medium to soft grained wheats are satisfactory (Simmonds 1989). For flat breads the flour should have a protein content of no less than 10% and should have extensible rather than stable dough characteristics (Simmonds 1989).

Biscuits, cakes and pastry manufacture needs soft wheats. The most suitable cake flour is milled from a soft, low protein wheat of low alpha amylase activity (Kent 1975). For steamed bread a cleanly milled flour with a protein content of about 10% gives the best results (McMaster and Moss 1989).

Overall, the ASW category is very well suited to most of these end uses including flat bread, steamed bread and pastry. In particular, ASW is very suitable for noodles with the cleanliness of Australian wheats also being an advantage. AH and APH which have higher protein contents are more desirable for pan bread production.

## Model

To estimate the premiums/discounts associated with the various quality characteristics the hedonic pricing approach is utilised. This approach has previously been applied to wheat by Ahmadi and Stanmore (1992), Larue (1991), Goodwin and Espinosa (1991), Wilson (1989) and Veeman (1987). It has also been applied to a wide variety of other industries such as wool, barley and cars.

The hedonic price approach postulates that the price of a heterogeneous good is a function of the characteristics of the good. It is based on the assumption that the consumers derive utility or satisfaction from the intrinsic characteristics of the good. That is, the individual characteristics are utility providing attributes in a consumer's maximisation problem. This assumption, along with that of perfect competition, allows the price of the good to be decomposed into parts expressing the contribution of specific characteristics to the overall utility gained from consuming the good. The model can be expressed as

$$r = \sum Tj\,Xj \qquad (1)$$

where

$r$ = price paid for the good,

$Tj$ = the hedonic price, which represents the premium/discount associated with characteristic $j$, and

$Xj$ = the quantity of characteristic $j$.

A regression of equation (1) tests the null hypothesis that the price of the good is not related to the quantity of its characteristics. That is, the regression determines the direction and magnitude of the characteristics impacting on the price of the good. Thus, the price of wheat is determined by a linear summation of the marginal implicit prices multiplied by the quantity or quality level of each characteristic.

## Data

The database for the study is from the Australian Wheat Board (AWB) which granted us access to information from previous Australian wheat export contracts to the respective markets. To our knowledge, this is the first study to utilise contract data to estimate the implicit values of wheat quality characteristics, as the previous studies by Ahmadi and Stanmore (1992), Larue (1991), Goodwin and Espinosa (1991), Wilson (1989), and Veeman (1987) all used annual average data. Annual average data may not tell as much about the individual characteristics because of its aggregated nature and, as such, may reduce the accuracy of the relationship among the variables. The contract data more accurately reflect the true market conditions and are thus more likely to result in the implicit prices estimated for the quality characteristics being closer to their true values. The data include the prices for, and sizes of, shipments of wheat to the markets, as well as six quality characteristics tested for in those shipments. These characteristics are test weight, protein, moisture, unmillable material, foreign material and falling number. Unfortunately, hardness is not a characteristic reported in AWB contracts. Test weight and protein are both desirable characteristics and would expect to earn a premium as they increase in magnitude. Moisture, unmillable and foreign material are undesirable and should result in discounts as there content rises. Falling number is a test that indicates amylase activity with an inverse relationship. Amylase activity is undesirable and therefore a discount would be expected which is indicated by a premium for falling number. The data size varies with particular markets but is quite large in most cases, covering a period from 1984 to 1991. All data were obtained in U.S. dollars with the results reported in Australian dollars (at A$1.00 = US$0.75).

## Results

The demand of each market is analysed by determining the implicit values of the six quality characteristics and testing the consistency of demand over two time periods. Implicit values are the changes in the price of a tonne of wheat when there is a marginal change in the level of a characteristic, changes that can be interpreted as premiums or discounts. The results are presented in the Tables 1–3 with the $t$ statistics reported in parentheses below the implicit values. The linearity of the model implies that the premiums/discounts remain constant across the range of the characteristics, but, it is quite likely that non-linear relationships exist at the extremities, particularly in the case of falling number. The results for the whole data sample are interpreted first, followed by a comparison of the results for the different time periods.

The results for individual markets over the period 1984 to 1991 are given in Table 1. The results for China are based on a data sample of 428 shipments. Various regressions were run to determine the characteristics which significantly influence the price of wheat in China and the size of the premiums/discounts associated with those characteristics. The only characteristic which significantly influenced the price was test weight, where a $0.57 premium was obtained for every extra kilogram per hectolitre per tonne of wheat.

The data sample for Japan includes 330 contracts. The results show that protein is the only characteristic to have a consistently significant impact on price, with a premium of $4.33 per each percent of protein.

The results for Indonesia are based on a data sample from 1985 to February 1991 which involved 173 contracts. They indicate that three variables — protein, unmillable material and falling number—consistently influence the price paid for wheat by Indonesia. The coefficients imply that a premium of $3.16/t of wheat is paid for each additional percent of protein. On the other hand, a discount of $1.31 is the result of a 1% increase in unmillable material. The discount for amylase activity, as represented by a premium for falling number, is $0.57 for every 10 seconds falling number increases.

The results for Malaysia are based on 470 contracts over the period 1984–1991 inclusive. The results indicate that Malaysia is a very quality conscious market, as four characteristics have premiums or discounts, with only moisture and unmillable material being insignificant. The results show a $1.15 premium exists for each extra kg/hL of test weight. The premium for protein is $3.65 per percentage point. For foreign material, the discount of $17.69 for every percent is large and demonstrates that Malaysian flour mills desire very clean wheat. This finding is supported by the extremely low levels of wheat purchased from the United States (a market share of only 8% in 89–90) which has a reputation for having higher dockage levels than other countries. Falling number is also a significant characteristic in Malaysia's decision to purchase wheat, which indicates a desire for sound wheat with low levels of amylase activity, although the premium—$0.25 for every 10 seconds increase in falling number—is not especially large.

The data sample of 91 contracts for the Singapore market is from 1984 to 1991. The results show that Singapore is a quality conscious market. The three significant characteristics—test weight, protein and falling number—all command premiums. The premiums of $2.55 and $9.44 for test weight and protein, respectively, are relatively large, especially when compared with those of other markets where these characteristics are insignificant. The insignificance of unmillable and foreign material indicates that Singapore may not be concerned about the cleanliness of the wheat, although a low amylase activity (high falling number) is highly rewarded.

The data sample for South Korea involves 165 contracts. The results indicate that South Korea may not be a quality conscious market, as none of the characteristics is significant. The most significant characteristic was foreign material, but the discount of $10.21 was significant only at the 20% level, which shows a rather inconsistent demand as the discount is not always assured of existing.

The analysis for Thailand is based on a data sample from 1984 to 1991 involving only 59 contracts. The results show that protein and falling number are the only two characteristics to consistently affect the price paid by Thailand. The $9.99 premium for protein is substantial, showing that protein is a key factor in the end uses of wheat in Thailand, while the premium for falling number is $0.61.

The results for the whole data sample indicate that certain Asian markets, such as Singapore and Malaysia, are very quality conscious with 3 or 4 characteristics having significant premiums/discounts. Indonesia and Thailand are also quality conscious, while Japan pays a significant premium for protein content. The individual quality characteristics of test weight, protein and falling number are the most important, being significant in almost half of the markets. The premium for protein ranges from 3.16 to 9.99 with the largest premiums being paid by the smallest Asian markets where Australia has a significant market share, Singapore (61%) and Thailand (21%). The premium for test weight indicates that although test weight influences price in some markets, the impact is rather small with only Singapore having a premium above two dollars. However, it should be noted that an increase of an extra kilogram per hectolitre may be easier to achieve than an extra percent of protein and thus a smaller premium for test weight would be expected. This is the case for falling number as an increase of 10 seconds in falling number is more likely and easier to achieve than an increase of 1% in protein. The largest premiums for falling number are paid by Singapore and Thailand. Unmillable material was significant only in one of the seven markets, while foreign material was significant only in Malaysia. This indicates either that most importers are not concerned about the cleanliness of the wheat or that Australia's unmillable and foreign material levels are always below the required level and thus there is no explicit reward for delivering extra clean wheat. The latter is the more likely case given Australia's reputation for delivering clean wheat and the reward may come through continued sales to these markets.

## Recent trends

To test whether any factors in the market had led to a change in the reward for any quality characteristics, the data were divided for each market into two periods; the first period ending, and the second period beginning, at the close of December 1987. These factors include technological advancement in the milling and baking industry, changes in consumer tastes which would show whether the change in demand for end products had led to a corresponding change in the valuation of the quality characteristics, changes in income growth which shift the demand for quality or significant trade policy actions, such as the U.S. Export Enhancement Program (EEP).

The results for the separate time periods 1984–87 and 1988–91 are presented in Tables 2 and 3, respectively. The regression results for China for both periods indicate that no characteristics are significant in either of the periods. This result is consistent with 5 of the 6 characteristics being insignificant in both periods as they are for the entire sample range, but the insignificance of test weight in either period may have been impacted by the smaller data sets. The significance of test weight for the entire period gives a better indication of the long run value of the characteristic and, as such, is a characteristic that should be highlighted in wheat sales to China. Apart from test weight, however, China pays little premium for quality wheat.

In Japan, there is consistency throughout the two periods as protein has a fairly consistent premium in both periods, as indicated in Tables 2 and 3. The remaining 5 characteristics are insignificant in both periods as they are for the entire sample range. Therefore, protein is the characteristic requiring greatest attention in exporting wheat to Japan.

In Indonesia, the results indicate that protein is the only characteristic to be significant in each period. It is obvious that the significance of the variables drops over the shorter period and smaller data base, as neither unmillable material nor falling number are significant in either period. The consistent

**Table 1.** Implicit prices of quality characteristics for 1984–91[a]

| Characteristic | Implicit price ($A/t) | | | | | |
|---|---|---|---|---|---|---|
| | China | Indonesia | Japan | Malaysia | Singapore | Thailand |
| Test weight (kg/hL) | 0.57 | | | 1.15 | 2.55 | |
| | (2.98) | | | (2.03) | (1.93) | |
| Protein (%) | | 3.16 | 4.33 | 3.65 | 9.44 | 9.99 |
| | | (3.99) | (4.16) | (4.82) | (4.63) | (5.03) |
| Unmillable material (%) | | −1.31 | | | | |
| | | (−1.91) | | | | |
| Foreign material (%) | | | | −17.69 | | |
| | | | | (−2.37) | | |
| Falling number (10 seconds) | | 0.57 | | 0.25 | 0.80 | 0.61 |
| | | (3.75) | | (2.14) | (2.89) | (2.52) |
| $R^2$ adjusted | 0.89 | 0.48 | 0.63 | 0.31 | 0.65 | 0.42 |
| Durbin Watson | 2.05 | 1.86 | 1.86 | 2.03 | 2.08 | 2.00 |
| Degrees of freedom | 426 | 168 | 328 | 465 | 87 | 56 |

[a]Moisture was an insignificant characteristic for all markets while there were no characteristics significant in South Korea.

**Table 2.** Implicit prices of quality characteristics for 1984–87[a]

| Characteristic | Implicit price ($A/t) | | | | | |
|---|---|---|---|---|---|---|
| | China | Indonesia | Japan | Malaysia | Singapore | Thailand |
| Test weight (kg/hL) | | | 2.07 | 3.56 | | |
| | | | | (2.70) | (1.94) | |
| Protein (%) | 6.11 | 5.17 | 4.23 | 12.01 | 5.76 | 11.85 |
| | (5.31) | (3.81) | (4.22) | (4.52) | (2.43) | (3.64) |
| Foreign material (%) | | | −29.72 | | | |
| | | | (−1.94) | | | |
| Falling number (10 seconds) | | | 0.39 | 0.68 | 1.21 | |
| | | | (2.54) | (1.93) | (2.98) | |
| $R^2$ adjusted | 0.49 | 0.67 | 0.38 | 0.66 | 0.17 | 0.46 |
| Durbin Watson | 1.90 | 1.92 | 1.96 | 1.97 | 1.96 | 2.04 |
| Degrees of freedom | 70 | 202 | 234 | 43 | 40 | 27 |

[a] Moisture and unmillable material were insignificant characteristics for all markets while there were no characteristics significant in China..

**Table 3.** Implicit prices of quality characteristics for 1988–91[a]

| Characteristic | Implicit price ($A/t) | | | |
|---|---|---|---|---|
| | Indonesia | Japan | Malaysia | Singapore |
| Protein (%) | 3.09 | 4.93 | 3.19 | 7.36 |
| | (3.93) | (3.96) | (3.44) | (2.88) |
| Falling number (10 seconds) | | | | 0.95 |
| | | | | (2.84) |
| $R^2$ adjusted | 0.41 | 0.64 | 0.24 | 0.47 |
| Durbin Watson | 1.78 | 2.09 | 2.02 | 1.73 |
| Degrees of freedom | 99 | 158 | 233 | 41 |

[a]Test weight, moisture, unmillable and foreign material were insignificant characteristics for all markets while there were no characteristics significant in China, South Korea or Thailand.

premium for protein indicates the importance of protein in wheat sales to Indonesia; however, the premium for lower levels of unmillable material and amylase activity has decreased.

The results for the two periods, 1984–87 and 1988–91, indicate that the Malaysian market may be becoming less quality conscious. In the first period, four variables— test weight, protein, foreign material and falling number—had a direct impact on the price paid for the wheat, but since 1988, Malaysia's demand for Australian wheat is less influenced by the quality characteristics of the wheat. Test weight and foreign material no longer have a significant impact on price, and though protein is significant in the second period, the size of the premium has dropped, indicating a reduced premium for quality. The insignificance of test weight and foreign material in the most recent period reduces their importance in wheat sales to Malaysia; however, attention should still be paid to the protein content and amylase activity of the wheat.

In the Singapore market, two characteristics, protein and falling number, have consistent premiums in both periods. However, test weight moves from having a significant premium in the earlier period to being insignificant in the latter. This fact indicates that Singapore is becoming less quality conscious with respect to test weight. The increased value of the *t*- statistic for protein indicates that this market is highly concerned about the protein levels but the reward for protein has decreased. Marketers and traders should be very concerned about the protein and amylase activity content in wheat exports to Singapore.

In South Korea, the results for each period indicate that the only characteristic to be significant in either period is protein, which was significant in the earlier period 1985 to 1987. The premium obtained for protein in this earlier period is $5.76 per percentage point. The fact that the premium for protein does not exist for the whole period from 1985 to 1991 shows the impact that the recent time period, where there is no premium for protein, has on the overall results. The insignificance of all characteristics over the whole sample and in the latest time period indicates that South Korea is not a very rewarding market for quality.

In Thailand, the results for the earlier period are consistent with the results for the whole data sample, as protein and falling number are the only characteristics to have significant premiums. These premiums are larger than those for the whole data sample. The results for the latter period indicate that protein and falling number do not influence price and thus demand is not consistent throughout. The insignificance of all the characteristics in the latter period may have been influenced by the small data sample (29 observations) which might have allowed one or two unusual contracts to distort the results. Overall, protein and falling number are the characteristics that should receive most attention in marketing and trade in Thailand, although their insignificance in the latter period implies that other factors such as credit arrangements may be more important in negotiating wheat sales to Thailand.

A comparison of the results across the two periods suggests that there has been a significant shift towards a lower reward for various quality characteristics. In the earlier period there are 12 characteristics significant in the seven markets, whereas in the latter period there are only five. Also, the premiums in the latter period are smaller, except for falling number in Singapore, than those obtained for the corresponding market in the earlier period. The most obvious observation is that test weight is significant for two of the markets in the earlier period but insignificant for all markets in the latter period. This tendency towards lower premiums may have been influenced by a number of factors, including the recent price war, increased blending technology or a change in consumer tastes.

The world wheat market has always experienced price competition, but in the early to mid 1980s the European Community (E.C.) began to substantially discount its wheat exports. However, it was not until the United States expanded its EEP in 1986 that the price war took off, with world wheat prices falling dramatically in the subsequent years (Roberts and Whish-Wilson 1993). The bulk of wheat exported by the European Community is medium protein, while the largest grade exported by the United States is hard red winter. Both of these wheats compete directly with Australia's ASW grade which represents around 70% of Australia's total wheat exports. The low prices for the E.C. and U.S. exports have meant that Australia has had to drop its price to compete as the importers' power in negotiations has increased due to the availability of cheap wheat elsewhere. Thus, the premiums/discounts received for quality characteristics in Australian wheat appear to have dropped in the emerging buyers' market. The decrease in the premiums/discounts could have been greater, had there not been significant income growth in the Asian region which has strengthened the demand for quality food products. The price war has had a much greater impact in the Middle Eastern region where income growth has not been as pronounced.

The trend towards a less quality rewarding world market may also have been influenced by recent technological advances in flour processing, milling and blending. For instance, technological advances may make the removal of foreign and unmillable material much less difficult or expensive than previously. Therefore, low levels of these characteristics are not rewarded in the latter period. Thus, technological advances may allow lower quality wheat to be used to achieve end products of the same quality as those previously achieved by higher quality wheats. Still more important is the increased potential to blend wheats, as this significantly affects the demand structure for wheats. For instance, a greater ability to blend will allow purchases of low quality wheat to be blended with higher quality wheat to achieve the desired quality. This is particularly relevant in the current price war as highly subsidised low quality wheat can be purchased and even stockpiled by importers to blend with higher quality wheats when required.

Together, the price war and technological advances allow importers to adapt their processing towards cheaper grades of wheat (usually of lower quality) which is reflected in the trend towards a less quality rewarding wheat market. The other factor that could reduce the reward for quality is that consumers tastes may have changed. That is, consumers may have realised or grown to accept that the end food products produced from slightly lower quality wheat and not much inferior to those from higher quality wheats and are therefore not willing to reward the higher quality wheat.

## Policy Implications

The findings of the study have significant implications for the Australian wheat industry, including the grading system, wheat breeding programs, handling and storage and marketing and trade.

The results suggest that quality characteristics are important in the buyers' decision to purchase Australian wheat. This implies that, in general, end users are willing to pay higher prices for higher quality wheats. This information needs to be signalled back to growers so that they can choose the appropriate varieties and farming practices to produce wheat with the desired qualities. In relation to the current grading system, the results support the payment differential for protein level in

general. The results also suggest that perhaps falling number should have a differential payment scale. However, the size of the premium is not significantly large, and may not be large enough to warrant the extra segregation costs. Previous estimates of segregation costs are rather limited but include a Prime Wheat Association (1984) estimate of $1.00/t to separate APH and AH (cited in Brennan 1984). The AWB (1987) estimated the cost of protein testing alone to be $0.53/t and thus the costs of separating the wheat according to quality levels are quite significant due to handling, storage and testing requirements. The implicit values of the remaining characteristics do not warrant a different payment scheme, especially considering the trend shown in the latter period (1988–91).

The implicit values for the associated quality characteristics are also of interest to wheat breeders so that they can allocate resources efficiently. Knowledge of these values indicates which characteristics should be concentrated on and what degree of variation is permissible. One of the major constraints for wheat breeding is that of having multi-quality requirements. Negative correlations exist, not only among quality characteristics but also among these and other factors in wheat breeding, such as yield and disease reaction (Brennan 1988). Knowledge of the premiums/discounts allows wheat breeders to undertake cost-benefit analysis when negative correlations exist between quality characteristics, and with the other factors such as yield and disease reaction. For example, the quality characteristics which have minimum values can be disregarded, with more emphasis being placed on finding higher yielding cultivars. The knowledge that protein, in particular, and test weight, moisture and falling number are significantly valued suggests that the resources must be allocated to find wheats that contain these characteristics at the desired levels. However, the fact that the premiums/discounts are not very large means that returns from the research may be low, especially if the desired quality levels in the wheat cannot be obtained without yield reductions.

The results are also of significance for the handling and storage of wheat as they highlight the characteristics that most attention must be paid to so that they remain at desirable levels throughout the handling and storage process. Protein and test weight are the most valued characteristics but perhaps a more important finding with respect to storage is that moisture is not a significant characteristic in any of the markets, while unmillable material or foreign material is only significant in two of the seven markets. However, falling number is significant in four markets and it is therefore important that attention is paid to the amylase activity level during the storage of the wheat. Accordingly, stored grain research into development of new technologies in line with these findings is warranted.

The implicit prices are equally relevant for developing efficient marketing and trade strategies. Protein is obviously the most important characteristic but, other quality characteristics such as test weight and falling number should also be emphasised, as they are certainly considered by importers when purchasing Australian wheat.

## Concluding Comments

The analysis shows that the Asian markets in general are very quality conscious, with significant premiums for certain characteristics. Given the likely increased demand for grain via impressive income growth in the Asian region, Australia should strive to supply the desired quality wheat to the particular markets and maintain or enhance its reputation for high quality clean white wheat which is very suitable for noodle production, the major end use in the region. However, one of the main findings of the study is that of the recent downward trend in the magnitude of premiums, implying that investigation into production of lower quality, higher yielding wheat cultivars is warranted. Although they need to carefully consider other factors which determine the decision to buy, such as credit arrangements, marketers and traders must still attempt to extract the largest possible premium for quality attributes of Australian wheat.

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