THE INFLUENCE OF SHORT-RUN PRICE VARIABILITY ON SYDNEY PORK PRICE SPREADS: A PRELIMINARY ANALYSIS +

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This study involved the analysis of price risk on monthly price spreads (or marketing margins) for pork in the Sydney market over the period January 1971 to December 1987. Although much has been written relating to risk in the production of agricultural products, little research has investigated the influence of price risk on marketing firms for these products.

To test for the impact of price risk on marketing margins for pork at both wholesale and retail levels, the model used by Griffith (1974) was adapted. Risk variables were defined based on suggestions by Brennan (1982) and Brorsen et al. (1985), and were added to the wholesale and retail margin equations.

Price risk did not prove significant in influencing either the wholesale or retail margins, in any of the alternate forms tested. Price levelling did exist at both levels. This may be a form of risk averse behaviour practiced by wholesalers and retailers to reduce the fluctuations of auction and wholesale prices. When the price levelling variables were omitted however, risk was still not significant. Price averaging did not prove significant in either form of the model.

1. INTRODUCTION

There has been a relatively long history of theoretical and applied research which has aimed to define and measure the influence of risk on the decision making processes of agricultural production enterprises. For example McCall (1967), Sandmo (1971), Turnovsky (1973), Anderson, Dillon and Hardaker (1977) and many others have developed theoretical models of the way in which competitive producers respond to price uncertainty. Trail (1978), Harrison (1980), Brennan (1982, 1983) and others have provided empirical evidence of the extent to which price uncertainty impacts on agricultural supply decisions. However until recently (Brorsen et al 1985, 1987), little research has been undertaken on the response to price uncertainty of firms processing and marketing agricultural products.

Firms involved in the processing and distribution of fresh meat in NSW face considerable short run variability in the prices they pay for their major raw material - livestock. There are no government intervention mechanisms which stabilise, support or otherwise modify the prices received by producers, and therefore the prices paid by initial buyers (typically wholesalers), or the prices charged by wholesalers or retailers higher up the marketing chain. Pork prices show similar degrees of short run variability as the other fresh meats.

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A considerable proportion of pigmeat in NSW is either sold by weight and grade direct to processors, or produced within vertically integrated structures, with transfers of product between different levels of the market being internalised within firms and therefore not subject to the full effects of market fluctuations. However most of the pigmeat which ends up in retail outlets as fresh pork would be valued through one of the auction selling systems. Recent research has shown pig prices obtained from the different auction sale methods are similar in magnitude and variability (Strong and Griffith 1988).

The degree of variability in Sydney pork prices and their associated price spreads is shown in Figures 1 and 2.

The objective of this paper is to test whether this observed variability in input prices is explicitly accounted for in the decision making processes of pork wholesalers and retailers in the Sydney fresh meat market. The paper is taken from Duff (1988).

Important policy implications may come out of such a study. One motive for frequent government intervention has been to stabilize prices and/or incomes for producers. Few previous studies take into account the fact that marketing firms face risks and hence price stability is expected to benefit such firms as well as producers and consumers. Brorsen et al (1987) suggested that government programs may be viewed in a new light after such a study. For example, in terms of benefits from risk reduction a price stabilisation program may be considered to have different effects from a deficiency payment scheme.

2. PRICE RISK AND MARKETING MARGINS

There are many forms which risk may take. Pickering and Cockerill (1984) point out four aspects of risk which may have an impact on an enterprise:

1. Market Risk - the characteristics of the market in which a firm operates;

2. Technological Risk - involves the development and implementation of new products and manufacturing processes;

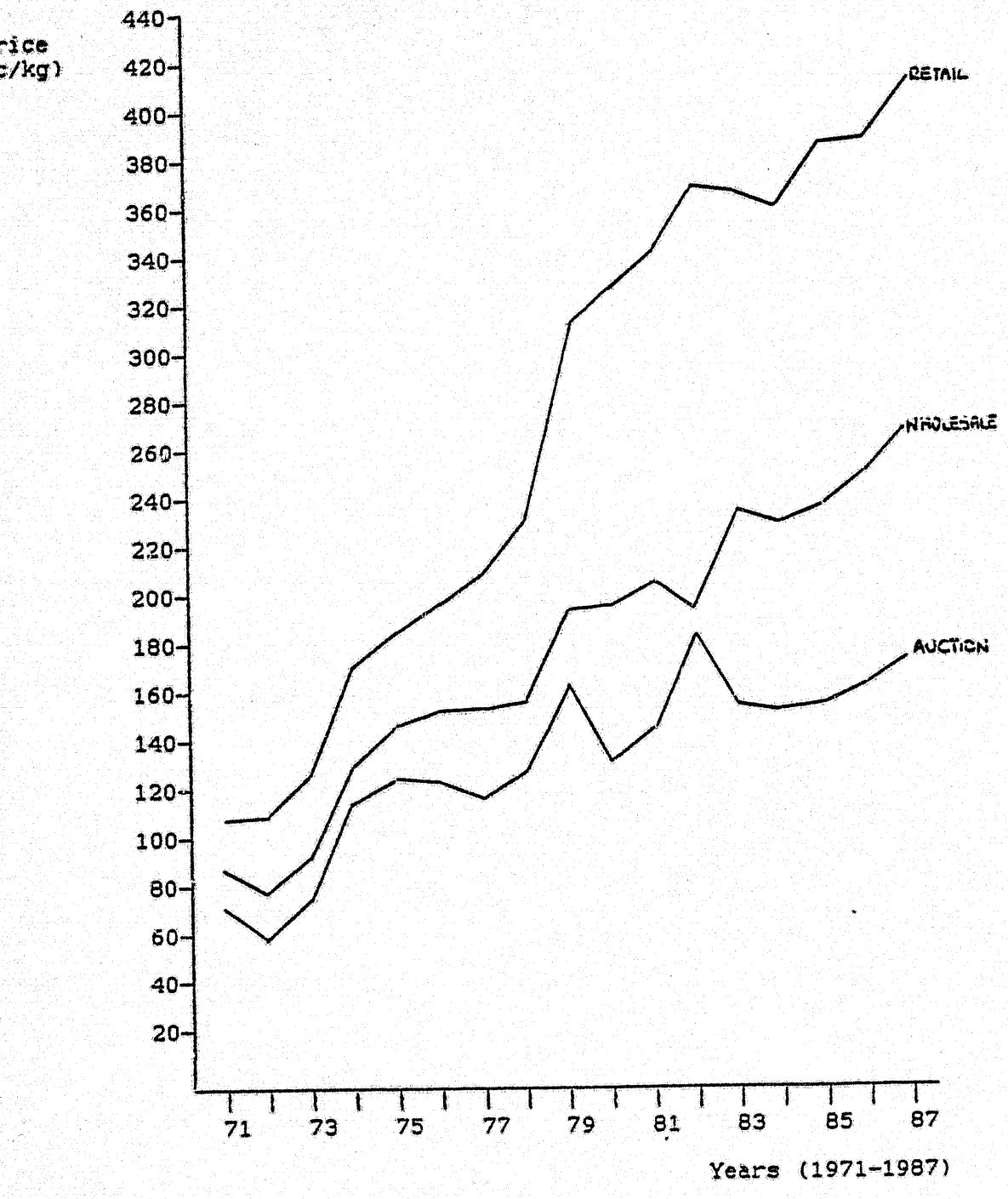
3. Factor Cost Risk - the main inputs of firms are materials, labour, energy, and capital and the costs of each of these may be subject to unexpected variations that can cause financial problems;

4. Political Risk - producers may face political risk on both domestic and foreign markets which would have adverse effects on decisions.

In this study, price risk will be specifically examined, which comes under aspect (3) above. However the other factors play an integral part in decision making.

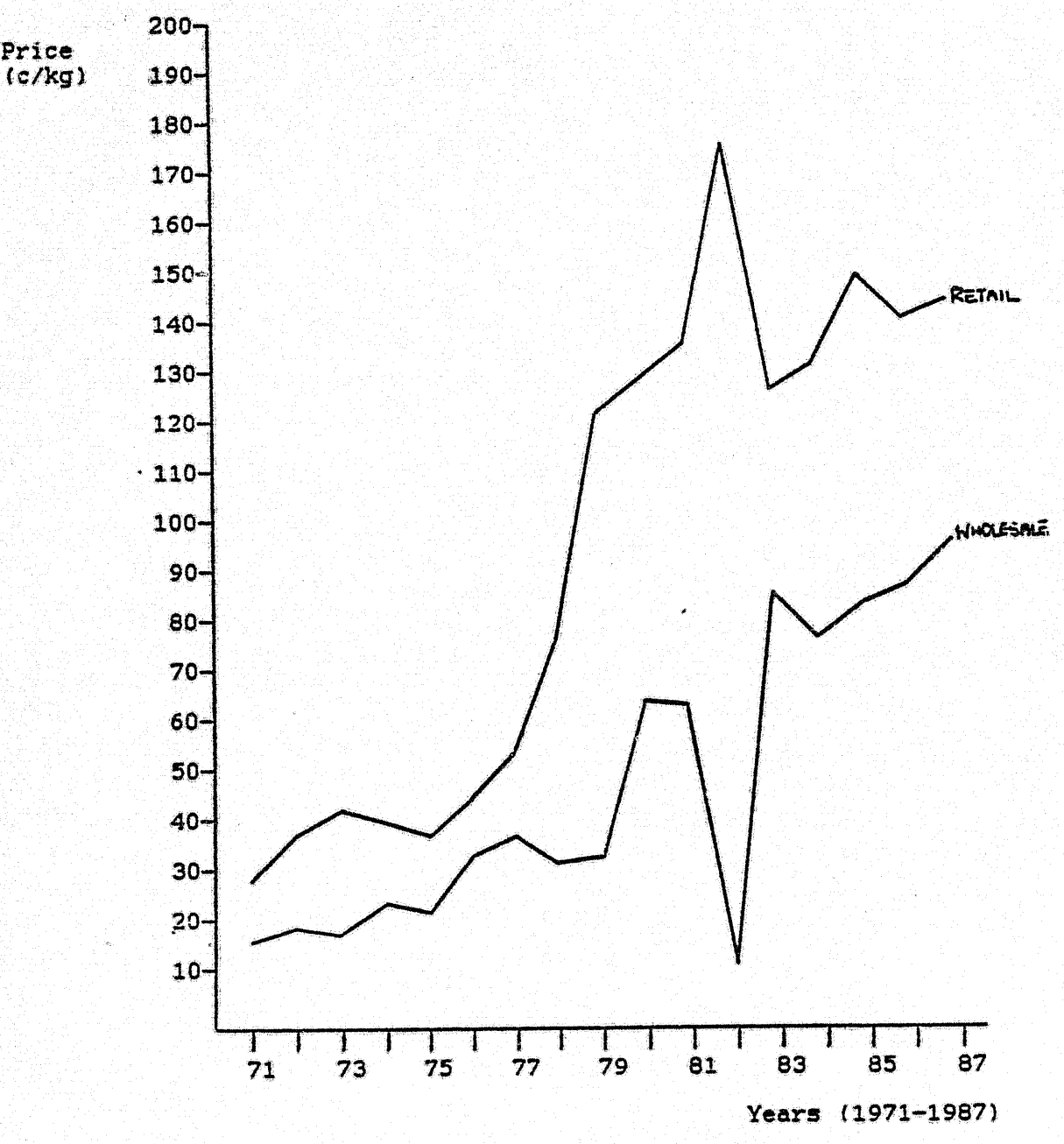
2.1 Price Risk in the Competitive Firm

Sandmo (1971) and McCall (1967) found that a competitive firm under output price uncertainty will produce less than the same firm without risk, providing it is risk averse. If the firm is found to be risk averse this negates the assumption that the demand for the product is known with certainty at the time the output decision is made (Sandmo, 1971). The approach taken by Sandmo was to assume that production decisions were made before the sales date, which is when the price becomes known.



Source: New South Wales Department of Agriculture.

Figure 1 Relationship of Auction, Wholesale and Retail Prices



Source: New South Wales Department of Agriculture.

Figure 2 Relationship Between Wholesale and Retail Margins

Turnovsky (1973) relaxed the assumption that production decisions are made before the market price is known for the next period and once decisions are made they are irrevocable. This is because it is a very restrictive assumption allowing no flexibility in the firms production decisions. By replacing this assumption he showed that a firm reacted to uncertainty. The expected output of a risk neutral firm will not equal the output with no uncertainty. Further, risk aversion doesn't necessarily mean that the firm will reduce its production plans below what it would chose if it were risk neutral.

Brorsen et al (1985) summarise this literature and with respect to a marketing firm, derive a positive coefficient on the risk variable.

Vertical integration may be seen as a method for reducing risks faced by firms. This is when successive stages of marketing or of production and marketing are linked together, often caused by inadequate coordination of existing markets (Tomek and Robinson, 1981). Vertical integration may reduce marketing costs and reduce price risk. Griffith and Gill (1985) conducted a study into the concentration of the N.S.W. pigmeat market and the effects on price spreads. They concluded that there is some evidence that the increasing levels of concentration in pigmeat production and marketing has contributed to increased price spreads for bacon and pork in NSW. The explicit effects of vertical integration could not be examined however.

2.2 Marketing Margins

Tomek and Robinson (1981) point out that elementary texts on price theory say very little about the differences between the prices received by producers and those paid by consumers - the marketing margin or price spread. This is particularly important in agricultural economics in terms of farm and retail prices. Farmers are often concerned about the costs of marketing services, especially in terms of the amount of the final consumers' dollar which goes to the middlemen involved in marketing, processing or wholesaling. However, Campbell and Fisher (1982) explain that farmers often tend to overlook many services which are required to satisfactorily market agricultural products including insurance, risk-bearing, interest on capital and depreciation on assets required to market the goods.

Tomek and Robinson (1981) define a marketing margin as the difference between the price received by producers and that paid by consumers, or as the price of the collection of these marketing services. The size and shape of the margin depends on the elasticity of the supply of marketing services. For example, if the supply of these services is perfectly elastic, this implies a constant margin as the demand for services increases.

Griffith (1974) conducted a study into Sydney meat marketing margins using simultaneous equation techniques. He examined the behaviour of wholesale and retail margins for beef, lamb, mutton and pork. Evidence of price averaging and levelling was found Levelling refers to the practice of wholesalers or retailers holding their selling prices relatively stable in times of fluctuating auction or wholesale prices. Averaging involves setting a lower margin on one meat type while recouping losses by setting a higher margin on another meat type. Levelling was found to exist at wholesale and retail levels for all meats. Averaging existed for all meats except mutton at wholesale and mutton and pork at retail. These two effects are often blamed for causing distortions in the price mechanism to the retail level, but Griffith (1974) found in the long run that retail and wholesale prices were quite responsive to auction price changes. The cost of providing retail marketing services was significant in determining all retail margins while wholesale costs were significant for beef and pork. Other studies by

Marceau (1967) and Tambi (1975) tested similar hypotheses again using an aggregate approach.

Naughtin and Quilkey (1979) suggest that limitations exist by using such an approach. A number of micro level relationships may be consistent with the macro relationships. Some macro observations may be observed by the approach, but the true explanation on a micro level may be hidden.

They attempted to model the pricing behaviour of retail butchers on a micro level basis, using the theory developed by Holton (1957) and Holdren (1960) in the supermarket context. This assumes kinked demand curves, so when prices are higher demand will be more elastic and less elastic when prices fall. They concluded that averaging and levelling may occur not just in the short run but also in periods of more than one quarter. This added to the previous research and possibly showed that the extent of price averaging and levelling was understated.

2.3 Risk Modelling in Marketing Margins

Little research has incorporated risk variables into econometric models of marketing margins. Brorson et al (1985) and Brorsen et al (1987) have been the major contributors in this field.

The former of these studies examined price uncertainty on the price spread in the marketing channel for wheat by adopting Sandmo's (1971) model. This analysis included farm-wholesale and wholesale-retail margins and provided evidence for the influence of price risk on the price mechanism.

The risk variable was obtained by assuming that the firms base their risk perceptions of the current market situation on a weighted moving average of the absolute value of price changes over the last twelve month period. These months are weighted from twelve to one for each of the twelve months. These measurements were then averaged to get a measure of the annual price risk. This was then divided by the annual average output price to reflect relative variability. Although they used monthly data to calculate the risk variable, their model was actually estimated using annual data. The farm-mill and mill-retail margins were jointly estimated by SUR.

The results showed that both margins increased due to the increase in output price uncertainty, suggesting that the competing firms are risk averse decision makers. As the retail demand for wheat is price inelastic, some of the increased margin would have been passed on to consumers (Fisher, 1981). Hence consumers would be paying more for flour because of risk factors.

Brorsen et al (1987) examined risk in the rice industry by taking a market equilibrium approach. This considers both producing and marketing firms, in a long run context which allows the number of firms to adjust as opposed to the short run approach in Brorsen et al (1985). Two risk variables were defined for this model, one which influences production and acreage response and the other reflects marketing risk. The latter is very similar to the approach used in Brorsen et al (1985).

The results showed risk was a statistically significant factor in acreage planted but larger risks do not necessarily imply large acreage changes. On the demand side risk was an important shifter in the supply of rice marketing services, being positive for both farm-mill and mill-retail equations. Rice millers were shown to be more responsive to changes in rice price variability than were retailers. This is probably due to the fact that millers sole business is rice, whereas retailers have many products of which rice is only one small component. So the results show substantial increases

in marketing margins so as to compensate the rice mills for the increased risk that they take.

3. SPECIFICATION OF THE MODEL

3.1 Equation Specification

3.1.1 Wholesale margin

Griffith's (1974) model specified the pork wholesale margin as a function of current and past auction price, wholesale marketing costs, wholesale margins for beef, lamb and mutton, and throughput. This model has been modified slightly to exclude mutton (consumption of fresh mutton is now very small). Two other exogenous variables were included - a lagged dependent variable, and risk, which will be discussed later. The lagged dependent variable is included as a consequence of a partial adjustment assumption. The hypothesis is that participants in the marketing chain do not completely adjust their production or pricing decisions in one period in response to a price change. This may be due to costs, capital or other constraints (Doran and Guise, 1984). By incorporating a lagged dependent variable possible problems of autocorrelation also tend to be overcome.

Price levelling is tested for by the inclusion of the current and lagged auction prices. If the current auction price has a significant negative coefficient, this suggests short run price levelling behaviour. A positive coefficient on the lagged auction price would suggest longer term coincidental adjustments of the margin to changes in raw material costs. Price averaging is also tested by including the margins for beef and lamb in the same equation as the pork margin. If a negative coefficient exists for these substitutes then averaging will be present. This will be the case if say a wholesaler sets a higher margin on beef in order to cover losses on pork.

Pork Wholesale Margin:

PWM = f(PAP, WHC, LPAP, BWM, LWM, TPUT, RSK, LPWM)

3.1.2 Retail margin

This is very similar to the specification of the wholesale margin. The retail margin is a function of current and lagged wholesale price, retail costs, beef and lamb retail margins, throughput, risk and a lagged dependent variable.

Pork retail margin:

PRM = f(PWP, RTC, LPWP, BRM, LRM, TPUT, RSK, LPRM)

3.2 Data and Variable Definitions

All data are available in monthly time series observations from January 1971 to December 1987. These were obtained from the NSW Agriculture & Fisheries, the Australian Meat and Livestock Corporation, the Homebush Abattoir Corporation, the Australian Bureau of Statistics and the Meat and Allied Trades Federation of Australia.

Variable definitions:

PAP = monthly adjusted auction price in c/kg of pork in dressed carcass

weight equivalent sold at Homebush saleyards (this is based on carcass weight of 100lbs up to 5th February 1974 and after this date is 45kg). These prices are adjusted to take account of shrinkage of the meat during transition to various market levels. NSW Agriculture & Fisheries.

LPAP = monthly weighted average of past adjusted auction carcass prices. This is given two different lag structures.

1. Griffith (1974) found the most appropriate lag structure to be the following:

   $$LPAP = PAP_{T-1} * 0.5 + PAP_{T-2} * 0.33 + PAP_{T-3} * 0.17$$

2. An arbitrary approach:

   $$LPAP = PAP_{T-1} * 0.8 + PAP_{T-2} * 0.2$$

   This lag structure assumes that most of the adjustment to a price change will occur in the next period.

PWP = monthly adjusted wholesale price in c/kg of pork carcasses sold through Homebush meat halls. NSW Agriculture & Fisheries.

LPWP = monthly weighted average of past adjusted wholesale prices in c/kg. The same weightings are used as with auction price.

BWM = monthly beef wholesale margin, which is the difference between the adjusted auction carcass price and the adjusted wholesale price for beef in c/kg. NSW Agriculture & Fisheries.

LWM = monthly lamb wholesale margin, which is the difference between the adjusted auction carcass price and the adjusted wholesale price for lamb in c/kg. NSW Agriculture & Fisheries.

BRM = monthly beef retail margin, which is the difference between the adjusted wholesale carcass price and the retail price for beef in c/kg. NSW Agriculture & Fisheries.

LRM = monthly lamb retail margin, which is the difference between the adjusted wholesale carcass price and the retail price for lamb in c/kg. NSW Agriculture & Fisheries.

WHC = as in Griffith (1974) a proxy was used for wholesale costs. Slaughtering fees constitute a large proportion of the wholesale costs, hence they are used as a proxy for all wholesale costs. The fees charged at Homebush abattoir are indexed with base period of January 1971 = 1.0. Homebush Abattoir Corporation.

RTC = monthly retail marketing costs. Again a proxy is used, this being the weekly wage rate for a General Butcher Shopman in New South Wales. Base period is January 1971 = 100. Meat and Allied Trades Federation of Australia and Australian Bureau of Statistics.

TPUT = throughput. Due to the closure of the Homebush abattoir, it was not possible to obtain throughput of local and interstate pork at Homebush meat halls. As a proxy New South Wales pork production had to be used. Australian Meat and Livestock Corporation.

LPWM = One period lag of the pork wholesale margin.

LPRM = One period lag of the pork retail margin.

RSK = Risk variable (see 3.3).

3.3 Risk Specification

Price risk is concerned with the variability associated with an estimate of the expected price. Risk is very much an ex ante phenomena and a method must be devised which attempts to model this in ex post terms, hence an approximation must be made (Traill, 1978).

Different specifications of risk are examined. Brennan (1982) suggests that the use of a moving range over three to four periods or the use of a moving standard deviation over three to four periods would be appropriate for measuring price risk. Other methods have been used which require more complicated estimation techniques. Such an approach will be adapted from Brorsen et al (1985).

Three risk specifications are used in this study.

RISK 1: This is simply a measure of the moving range over three and four periods and involves the assumption that perceived risk is equated with variability in the recent past, and that present riskiness is also related to the risk in the recent past (Brennan, 1982).

RISK 2: This is a measure of the moving standard deviation over three periods and four periods respectively. This method involves the implicit assumptions mentioned for RISK 1.

RISK 3: A more complicated method used by Brorsen et al (1985). A weighted moving average of the absolute value of price changes over the last twelve month period is calculated. These months are weighted from twelve, eleven, ten,.....,one for each of the twelve months. These measures are then averaged, and divided by annual output price which gives a measure of relative variability.

The general case exists as:

$$risk_t = \frac{(|P_{t-12}-P_{t-11}|*1 + |P_{t-11}-P_{t-10}|*2 + \ldots + |P_{t-1}-P_t|*12)/12}{\sum_{t-11}^{t} P_t /12}$$

where: P = PAP or PWP for wholesale and retail margins respectively.

Two modifications of the original lag of twelve months are made. Moving weighted averages over six and three months are also tested. This approach is taken to see if decision makers form their expectations on the immediate past (three months) on on a longer lag length (six to twelve months).

3.4 Estimation of the Model

The model is estimated over the data period using ordinary least squares. This is appropriate because only a single equation is being estimated at a time.

3.5 Null Hypotheses to be Tested

1. Ho: Price levelling does not significantly influence the wholesale margin for pork in the Sydney market.

2. Ho: Price levelling does not significantly influence the retail margin for pork in the Sydney market.

3. Ho: Price averaging does not significantly influence the wholesale margin for pork in the Sydney market.

4. Ho: Price averaging does not significantly influence the retail margin for pork in the Sydney market.

5. Ho: Price risk does not significantly influence the wholesale margin for pork in the Sydney market.

6. Ho: Price risk does not significantly influence the retail margin for pork in the Sydney market.

Hypotheses (5) and (6) include the different risk specifications as defined previously.

4. DISCUSSION OF RESULTS

Several variations of the model were examined in the estimation and these are discussed below. The criteria for testing the significance of the relevant variables are t-tests. Durbin-Watson and Durbin H tests are also used to test for autocorrelation.

Under initial estimation the risk variable was insignificant at wholesale and retail levels for three different risk specifications. R^2's were relatively high for these estimates. Correlation matrices revealed high correlations between PAP (PWP) and LPAP (LPWP) which were to be expected. At retail level BRM, LRM and RTC had some high correlations. The correlations between the remaining variables seemed acceptable.

Correlation did not typically exist between risk and price or between risk and lagged price at either level. However the potential problem is that while correlation between risk and these two variables individually is not significant, when these two variables are in the same equation together they may effectively measure the same thing as the risk variable. That is, the way in which the prices change from period to period.

Modifications were made to the model to exclude variables which estimate the same behaviour as the risk variable. Regressions can then be carried out on wholesale and retail margins with the regressor variables being wholesale (retail) costs, throughput, risk and the lagged dependent variable. This approach sought to disaggregate the above proposed influences and provide more of a longer run supply of marketing services relationship. However if the short run margin determination equation really should have price levelling and averaging variables included, then we are misspecifying the model by omitting them. A more formalised way of checking the relationship between the price and risk variables may be to regress risk on the two prices.

To aid in the analysis of the results the following definitions are used. The long equation refers to the full equation as defined in sections 3.1.1 and 3.1.2 which include the risk variables. The short equation refers to the modified equations which include costs, throughput and the risk variables in the wholesale and retail margins.

The different specifications for the lagged auction (wholesale) price were estimated but no significant differences occurred between the two specifications. Therefore the first specification is used for consistency

with the approach used by Griffith (1974).

4.1 Parameters of the Wholesale Price Spread

4.1.1 Wholesale margins: risk versus no risk

The model used by Griffith (1974) was estimated and results are shown in Table 1 (values in parentheses are t-ratios). Both pork auction price and lagged pork auction price were significant. Current auction price has a negative coefficient and lagged auction price is positive, suggesting the existence of price levelling. This confirms Griffith's (1974) findings. Both beef and lamb margins were insignificant in influencing the wholesale margin, ruling out the possibility of price averaging, which is contrary to previous results. Throughput had a positive and significant effect. The lagged dependent variable was highly significant but this is to be expected. Wholesale costs were insignificant.

A risk variable was then added to this equation. In this case RISK 3 using a weighted moving average over twelve months was used. From Table 1 it is evident that only very small changes occurred to the coefficients of the existing variables. The risk variable was not significant (t ratio of 0.48). Hence the risk variable did not significantly influence the wholesale margin. $\bar{R}^2$'s were very similar in both equations as were the Durbin-Watson statistics.

Table 1 COMPARING RISK AND NO-RISK EQUATIONS AT THE WHOLESALE LEVEL

Without Risk

PWM = -8.074 - 0.755*PAP + 0.775*LPA + 0.454*WHC + 0.015*BWM + 0.042*LWM
(-1.35) (-9.95) (9.96) (0.46) (0.26) (0.88)

+0.002*TPUT + 0.809*LPWM
(2.20) (23.86)

$\bar{R}^2$ = 0.924 DW = 1.96 DH = NA

With Risk

PWM = -9.075 - 0.751*PAP + 0.775*LPA + 0.443*WHC + 0.012*BWM + 0.037*LWM
(-1.42) (-9.67) (9.65) (0.43) (0.21) (0.73)

+0.002*TPUT + 0.812*LPWM + 28.09*RISK3
(2.07) (22.93) (0.48)

$\bar{R}^2$ = 0.919 DW = 1.96 DH = NA

4.1.2 Risk variables in the wholesale margin

Table 2 presents the different risk specifications incorporated into the original model. The elasticities at the means are used as the basis for comparison. Although none of the risk specifications were significant under t-tests some trends can be observed. It appears that as the period of measurement declines, the significance levels tend to increase. That is, the three month periods for risk specifications 1, 2 and 3 are approaching significant levels. The negative elasticities do not seem consistent with a

priori expectations, that is a risk averse firm would be expected to set a higher margin in times of increased price risk, although little importance can be placed on signs when results are insignificant. Further, the results accord with Brennan (1982) who found that the moving range and the moving standard deviation were closely correlated when the number of lags was small.

Table 2 COMPARING RISK VARIABLES AT WHOLESALE LEVEL: LONG EQUATIONS

risk specification	months			
	12	6	4	3
1.	**	**	-0.0090 (-0.3470)	-0.0385 (-1.6500)
2.	**	**	-0.0929 (-0.3400)	-0.0397 (-1.7100)
3.	0.0263 (0.4836)	-0.0031 (-0.0946)	**	-0.0244 (-0.8721)

Table 3 COMPARING RISK VARIABLES AT WHOLESALE LEVEL: SHORT EQUATIONS

risk specification	months			
	12	6	4	3
1.	**	**	0.0082 (0.2616)	-0.0447 (-1.5948)
2.	**	**	-0.0167 (-0.5154)	-0.0438 (-1.5804)
3.	0.0080 (0.1241)	-0.2283 (-0.5732)	**	-0.0517 (-1.5064)

Alternative equations were developed in an attempt to disaggregate the possible influence of the two price variables explaining some of the risk variable. Therefore the regression was carried out with pork wholesale margin as a function of wholesale costs, throughput, risk and the lagged dependent variable.

Table 3 shows the results of the different risk specifications under the alternative method. Similar trends can be observed as with the original approach. Risk variables were insignificant under t-tests, but significance did seem to increase as the lag structure decreased. Once again the signs of the elasticities were negative implying that as risk increased (decreased) the margin would decrease (increase), which is contrary to a priori expectations.

The two other variables included in the short equations were wholesale costs and throughput. In the long equations for the wholesale price spread, throughput was positive and significant, while wholesale costs were positive and insignificant. In the short equations the opposite situation occurred for

both variables. Wholesale costs were positive and significant whereas throughput was insignificant.

Based on a priori experience it is very difficult to try and explain the behaviour of the throughput variable. It would be expected that throughput would influence both long and short equations, but in a negative manner. This has been the case with previous studies including Griffith (1974). Some explanation for the results could be attributed to the data. New South Wales production had to be used instead of the more appropriate measure, the number of head through Homebush meat halls.

The behaviour of the wholesale cost variable is more readily explained. As slaughtering charges do not change frequently, their effect in the short run may not be significant, compared to the effect of auction price. In the short equation the influence of costs may be greater because the short term effect of prices is omitted. This explanation would be consistent with the results obtained.

4.2 Parameters of the Retail Price Spread

4.2.1 Retail margin: risk versus no risk

The no risk model results are shown in Table 4. Similar to the wholesale situation, both current wholesale price and lagged wholesale prices are highly significant, with current price having a negative coefficient and lagged price being positive, suggesting price levelling exists at the retail level. The beef and lamb retail margins were not significant in influencing the margin, hence price averaging does not appear to exist in this data set. These findings confirm the earlier results of Griffith (1974). None of the other variables are significant under t-tests except the lagged dependent variable.

When the risk variable (Risk 3: 12 month lag) is added to this model no significant changes result (Table 4). The beef retail margin approaches a more significant level, suggesting some complementarity rather than averaging may exist between beef and pork at retail level, but this is not conclusive. Significant price levelling still exists. R^2's and Durbin statistics are very similar, for both equations.

4.2.2 Risk variables in the retail margin

In Table 5 the results for the different risk specifications are presented. Risk 1, with a 3 month moving range and risk 2, with a 4 month moving standard deviation are significant at a ten percent level t-test, but overall the results are far from being conclusive.

As with the wholesale margins the risk variables tend towards significance as the period of measurement decreases, and again the results support Brennan's (1982) observations concerning the similarity between the moving range and moving standard deviation. However contrary to most other results, all risk coefficients are positive in this Table.

The short equation has retail margin as a function of retail costs, throughput, risk and the lagged dependent variable. Once again price risk was insignificant for all three risk specifications and most risk variables changed sign from the long equations (Table 6). The two other variables included in the equations are throughput and retail costs. In the long equations both of these were insignificant, but when included in the short equation both were significant. Retail costs have a positive elasticity, whereas throughput is negative in all cases.

Table 4 COMPARING RISK AND NO-RISK EQUATIONS AT THE RETAIL LEVEL

Without Risk

$$PRM = \underset{(1.91)}{12.30} - \underset{(-7.72)}{0.658}*PWP + \underset{(6.74)}{0.636}*LPW + \underset{(0.26)}{0.012}*RTC + \underset{(0.13)}{0.117}*BRM + \underset{(0.06)}{0.050}*LRM$$

$$-\underset{(-1.73)}{0.022}*TPUT + \underset{(22.51)}{0.849}*LPRM$$

$R^2 = 0.948$ DW = 2.43 DH = NA

With Risk

$$PRM = \underset{(1.70)}{11.97} - \underset{(-7.57)}{0.661}*PWP + \underset{(6.50)}{0.632}*LPW + \underset{(0.36)}{0.018}*RTC + \underset{(1.77)}{0.115}*BRM + \underset{(0.74)}{0.049}*LRM$$

$$-\underset{(-1.67)}{0.002}*TPUT + \underset{(21.46)}{0.846}*LPRM + \underset{(0.29)}{19.49}*RISK3$$

$R^2 = 0.945$ DW = 2.41 DH = NA

Table 5 COMPARING RISK VARIABLES AT RETAIL LEVEL: LONG EQUATIONS

risk specification	months 12	6	4	3
1.	**	**	0.0124 (1.4500)	0.0134 (1.8057)
2.	**	**	0.0149 (1.7659)	0.0111 (1.5689)
3.	0.0047 (0.2859)	0.0135 (1.4083)	**	0.0110 (1.2120)

A similar argument may be used for retail costs as with wholesale costs. That is in the long equation the influence of price may mask the more stable butcher's wages but in the short equation, retail costs become more significant as it is measuring a longer term relationship. Finding an explanation for the change in the significance of the throughput variable seems difficult.

Table 6 COMPARING RISK VARIABLES AT RETAIL LEVEL: SHORT EQUATIONS

risk specification	months 12	6	4	3
1.	**	**	-0.0085 (-0.9782)	-0.0081 (-1.0760)	
2.	**	**	-0.0033 (-0.3646)	-0.0014 (-0.1800)	
3.	0.0033 (0.1854)	0.0102 (0.7837)	**	-0.0130 (-1.1364)	

4.3 Discussion of Overall Trends

Through both the wholesale and retail margins some definite trends emerged:

* The adjusted pork auction (wholesale) price was always highly significant with a negative coefficient.
* Lagged adjusted pork auction (wholesale) price was always significant and positive.
* Beef wholesale (retail) margin was always insignificant.
* Lamb wholesale (retail margin was always insignificant.
* In the long equations, wholesale (retail) costs were insignificant.
*In the short equations, wholesale (retail) costs were significant and positive.
* For the wholesale margin throughput was significant in the long equations but insignificant in the short equations.
* For the retail margin throughput was insignificant in the long equations, but significant and positive in the short equations.
* Risk was insignificant for all three specifications at both wholesale and retail levels, in the long and short equations.

4.4 Hypotheses Tested

The statistical significance of the above trends were based on t-tests at a 95 percent level of significance.

The hypotheses will be dealt with individually as in section 3.5.

1. Price levelling exists at the wholesale level for pork in the Sydney market. In all models the current auction price was negative and highly significant, while the lagged auction price was significant and positive. This means that the price and margin will move in the opposite direction in the short run but as time increases the margin responds to the change in price in a positive fashion. H_o rejected.

2. As with hypothesis 1, price levelling exists at the retail level. H_o rejected.

3. Price averaging does not significantly influence the wholesale

margin for pork in the Sydney market. Both the beef and lamb wholesale margins are positive yet insignificant. H_o accepted.

4. Price averaging does not exist at the retail margin. As with wholesale margin, beef and lamb retail margins do not have significant elasticities, although the beef margin does tend to approach more significant levels. H_o accepted.

5. Price risk was found to be insignificant in influencing the wholesale margin for pork. All three risk specifications had this result. When current and lagged prices, and the margins for beef and lamb were omitted, the risk variables were still insignificant although the variables tended to approach levels of significance when the period of measurement declined. H_o accepted.

6. The influence of price risk on the retail margin for pork produces the same results as for the wholesale margin. All three risk specifications were insignificant in both the long and short equations. H_o accepted.

5. CONCLUSIONS, IMPLICATIONS AND LIMITATIONS

5.1 Conclusions

This study considered the influence of price risk on marketing margins for Sydney pork. To test for this the basic short run margin model used by Griffith (1974) was adapted and a price risk variable included. Specification of the risk variables were based on an examination of the literature including Brennan (1982) and Brorsen et al. (1985). Within the framework of the model price levelling and averaging were also tested. The effects were investigated from 1971 to 1987 using monthly data.

The analysis showed that price risk was not a significant factor in influencing the marketing margins at either wholesale or retail levels. Based on a priori assumptions it would be expected that price risk would influence such firms. As outlined in the literature a competive firm under output price uncertainty will make different decisions to the same firm with no uncertainty. Different forms of price risk variables were examined which have been used successfully by other authors, but in this study there were no conclusive results. One main trend was that the risk variable approached more significant levels as the period of measurement of risk declined. This may mean that the price risk is a shorter term phenomenon than was previously believed.

Price levelling was found to exist at both market levels. This means that wholesalers or retailers hold their output prices relatively stable in times of rising and falling input prices. Although this was not suggested earlier in this study this type of behaviour may be seen as a form of risk reducing activity practiced by both wholesalers and retailers to reduce the effects of large fluctations in the auction price. If the firm could hedge against price changes on a futures market this would provide an additional method for reducing risk. Price averaging was found not to be significant at either level.

In terms of policy implications very little has come out of this study. As mentioned previously if price risk influences marketing firms then price stabilization schemes should benefit these firms as well as producers and consumers. The results suggest that price risk is not significant in influencing the margin hence policies such as price stabilisation programs or a deficiency payment scheme would not alter the decisions made by marketing firms, with respect to the variability of prices paid for livestock.

5.2 Limitations

In this study problems existed in obtaining consistent data. Throughput data from Homebush meat halls were unavailable due to the closure of the abattoir. Thus a proxy had to be used, namely the production of pigmeat in New South Wales. It is probable that this data does not exactly measure the true throughput variable. This may well explain the inconsistent results obtained for throughput at both wholesale and retail levels.

Risk is an ex ante phenomenon. There is little doubt that risk influences decision making, but the problems in measuring risk may be because it is being measured ex post. Much of the price risk variable could be explained by the other price variables, perhaps leading to the insignificant results.

5.3 Areas For Further Research

Trying to measure price risk as a function of past prices may not be

totally appropriate. An alternative approach would be to obtain a measure of the expected price and to see how this differs from the actual price. This would tend to measure price risk ex ante rather than ex post. However both Traill (1978) and Brennan (1982,1983) found risk variables defined as the difference between an expected price and the actual price to have similar explanatory power to risk variables based on the recent variability in prices. Additionally there is the problem of defining how expectations are formed.

It would also be appropriate to set the model up for all the meats (pork, beef and lamb) as in Griffith (1974). This would enable a simultaneous examination of all the trends in marketing margins for the Sydney market, which may better explain the price averaging phenomena found in previous work. Further, since the wholesale and retail margins are in effect determined simultaneously, a system estimator would be appropriate as well.

There is the possibility also that it is not price variability but throughput variability which is important to the profitable operation of fresh meat processing and marketing firms in Sydney. Including quantity measures of risk would provide a more complete approach.

Finally there are some econometric problems unattended to. These include the use of nominal instead of real prices, and attendant issues of heteroscedasticity, and the omission of monthly dummy variables.

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