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AN ANALYSIS OF THE PRICE BEHAVIOUR OF SELECTED VEGETABLES AT A  
NEW ZEALAND AUCTION

A thesis presented in partial fulfillment of the  
requirements for the degree of  
Master of Business Studies  
at Massey University

Stephen John Wright

1987

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I remember thinking, when I started this thesis, that someone, somewhere, had just finished one. It is nice to be finishing this thesis, and thinking that someone, somewhere, is just starting one!

## ABSTRACT

The immediate and short run behaviour of prices and volumes of eighteen vegetables at auction are examined. The objectives were to describe the behaviour of weekly prices and volumes and to investigate various relationships.

The data analysed are weekly volume and turnover for eighteen vegetables at a Palmerston North auction for a three year period. Various climatological variables relating to the same period were also analysed.

Much of the descriptive analysis relies on the techniques of Exploratory Data Analysis; boxplots, letterplots, and a resistant smoother are used extensively. These methods facilitate the analysis of the behaviour of prices and volumes over time.

The auction marketing system is discussed at length, with particular emphasis on the effect of length of run on supply response.

Various relationships are examined predominantly using stepwise regression. These include: current price and quantity; current quantity and lagged price; quantity and month of the year; price and month of the year; price and various weather variables; quantity and various weather variables; current price and lagged price.

Some transformations are used to try to get a more linear relationship between price and quantity. This relied on fitting several resistant lines, another EDA technique.

The interdependence or interrelationship of prices was examined using Principal Components Analysis, and five principal components were extracted and described.

Some useful insights into the behaviour of the market are gained. Immediate run price variation, that is from week to week, is quite large and this is reflected in low R-squared values for the price-volume relationships. The relationship between current marketed volume and lagged prices was also investigated. The results indicate that in the immediate run, using weekly prices, this relationship is weak.

Arguably the most useful analysis was the monthly price boxplots which give a clear graphic display of the behaviour of prices. These and the other plots give indications as to when prices were highest and lowest. They may be useful to growers in planning production and harvesting.

It was discovered that weekly prices were more variable than weekly volumes for 10 vegetables, less variable for six vegetables, and equally variable for two vegetables. Often the highest weekly price did not coincide with the lowest weekly supply, and the lowest price did not correspond to the highest supply. This suggests that bidders under or over estimate the quantity on the floor and each other's requirements.

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## CHAPTER 1 INTRODUCTION

### 1. Agricultural Price Analysis

There are two reasons for conducting research into the behaviour of prices. One aim is to explain and estimate the impact of certain variables on demand. For example, Tomek and Robinson (1981) state interest in estimating "specific economic coefficients (parameters) such as price and income elasticities of demand". Waugh (1964b) has pointed out that pricing studies contribute to the development of theories of demand.

Secondly, price analysis might provide "forecasts of prices or the variables affecting prices." (Tomek and Robinson, 1981). Waugh (1964b) comments that forecasts of future prices are needed by farmers to help them decide when to sell. Price forecasts could also help growers decide what to plant, when to plant, and when to harvest.

This study examines immediate and short-run price and quantity behaviour which might be useful for forecasting, although no formal forecast is made.

During the 1940s and 1950s much research was conducted on supply relationships in agriculture and there is a huge and diverse literature on the nature of agricultural supply. A useful review of this literature is provided by Tomek and Robinson (1977).

Heien (1977) notes that since the 1930s policy makers in the United States have been concerned with supply response, especially in relation to the problem of farm income. Tomek and Robinson (1977) point out that most research of this type has used time series data and single equation models estimated by least squares regression.

Much research on agricultural commodity prices deals with grains and livestock. More recently, some research dealing with fruit and vegetables has been undertaken. For example, Janssen (1978) studied short-range prices in German fruit markets, and Venzi (1974) applied time-series analysis to flowers and vegetables in Italy.

There are only a few studies dealing directly with the prediction of prices of vegetables at auction. For example, Lee (1973) analysed price formation at a New Zealand auction, and Goossens and Boddez (1986) examined price behaviour of vegetables at Belgian auctions.



## 2. New Zealand Vegetable Price Studies

Research concerning price formation of vegetables in New Zealand has been conducted by Enting et al (1965), Kitson (1968), Philpott and Bourke (1971), Ridler (1966) and Lee (1973). Lee (1973) suggests that the reason that little research has been conducted on short term price fluctuation is the "difficulty of obtaining and handling time series data." Another reason was the shortage of published statistical information on the vegetable industry. In fact, this data availability problem appears to be worsening, with collection of vegetable production and acreage figures by the Ministry of Agriculture and Fisheries being discontinued after 1982.

Studies of the price behaviour of fresh vegetables in New Zealand have found that prices at all distribution levels fluctuate considerably.

At the retail level, for example, 50 percent to 100 percent variations in the annual price per pound of cabbages were common in the period 1949 to 1964. Cauliflower retail prices behaved similarly, and the retail price of onions had an average annual fluctuation of 35 percent between 1950 and 1963 (Enting et al, 1965).

However, vegetable price fluctuations at auction were found to be even greater than at the retail level (Philpott and Bourke 1971).

Wholesale prices of onions in the years 1950 to 1963 had an average annual fluctuation of 54 percent, compared to the 35 percent retail price fluctuation previously mentioned. On the other hand, onion production levels, area and yield per acre had a lower average variation of 19 percent, 14 percent and 7 percent respectively. Intuitively, one can conclude that at that time, (and probably still), demand for onions was price inelastic.

The smaller price variations at the retail level have been attributed to the rigidity of fixed margins and marketing costs. Historically, retail prices have been flexible. According to Enting et al (1965), retail prices "sustantially reflect changes in the overall supply position between main crop seasons.....They may be more "sticky" as regards short term changes, such as week to week irregularity in auction supplies, but the variation in seasonal average prices undoubtedly indicates that the price mechanism does perform in some degree its function of clearing supplies of perishable produce." Kitson (1968) found that average retail margins ranged from 25 percent to 33 percent.

However, different factors explain changes in farm prices. Enting et al (1965) assert that retail margins were excessive and that their fixed nature contributed to farm price instability.

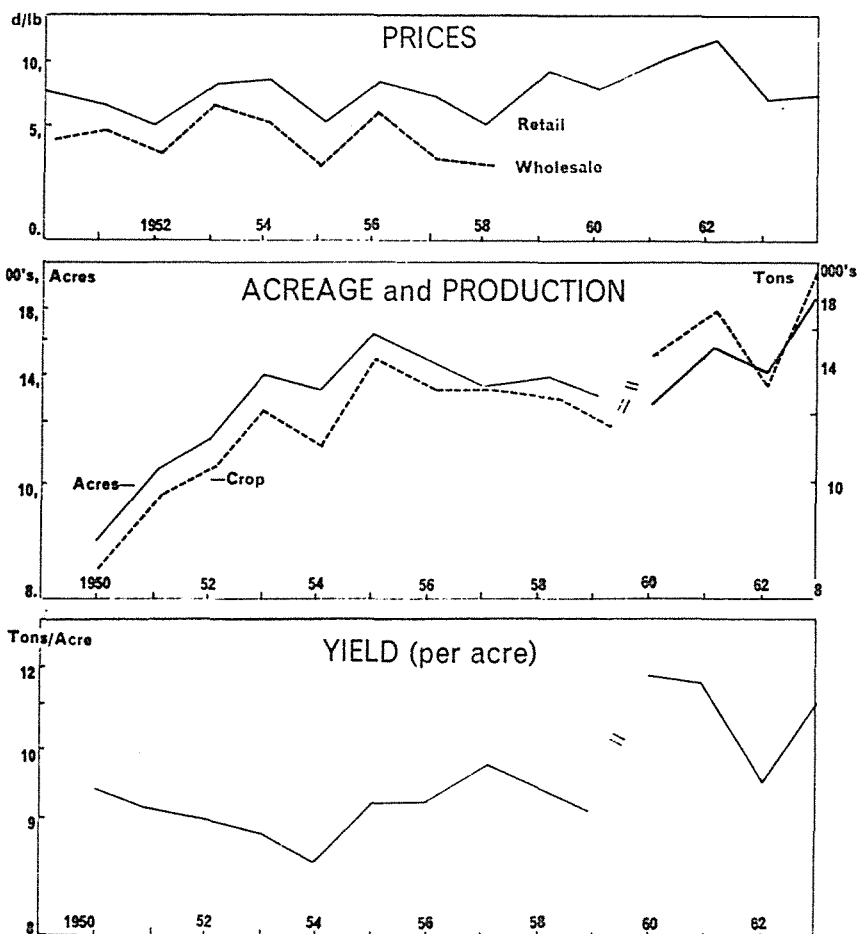
According to Ridler (1966), the volume which is supplied, the cost of marketing, and the flexibility of retail prices largely determine auction prices.

Enting et al (1965) found that the large variation in prices was not predominantly due to the effects of weather or other uncontrollable elements, but to changes in planned production. Examination of graphs of acreage, production, and prices for onions from the 1964 study by Enting et al (1965) reveal that acreage planted increases after a price increase and decreases after a price decrease. According to Enting et al acreage responds in general to the previous years prices and tends to move in the same direction. The writers of the report presume that the same might apply to other vegetables whose price behaves in a similar way to that of onions.

-----  
 ONIONS: Graphs from the 1964 study  
 -----

## ONIONS

Production and Prices in New Zealand 1950-64



However, Philpott and Bourke (1971) found that price changes were not followed by acreage changes in the same direction in the following year but that, for example, "a major price rise in 1965... (was)... followed by a reduction of onion acreage of some 100 acres in the following year." They found that when the retail price for onions was higher than the previous year, output was lower than the previous year, and that when prices were lower than the previous year, output was higher. They contend that low prices are primarily caused by variation in output, not by changes in demand.

### 3. The Effects of Price Instability

These farm price fluctuations are of particular concern for growers. In the 1964 study of the economic position of the fresh vegetable industry in New Zealand, the investigation panel had this to say about the market:

"The fresh vegetable market is subject to severe and unpredictable changes in prices, a situation which leads to social waste, prevents the efficient planning of production by the individual grower, and is the root cause of many of the difficulties for which the marketing system is blamed." (Enting et al, 1965).

Prices affect industry growth, the incomes and wealth of growers and auctioneers, the speed of growth, production decisions, and numerous other factors.

Daly (1958) notes that agricultural products have low price elasticity of demand and that when farm production differs much from quantity demanded growers experience considerable instability in prices and incomes.

Cochrane (1958) lists the problems of price variability as variable farm incomes, low incomes over extended periods, and uncertainty in planning production. He notes two types of price variability; price level fluctuations, which tend to be high during war years and boom times and low after wars and during recessions; and commodity price fluctuations. The first leads to an income problem in agriculture, the second leads to an uncertainty problem.

If prices are unstable, growers' gross incomes fluctuate. This has implications for financing decisions. An uneven cashflow will at times necessitate borrowing to finance production plans. At other times cash will be abundant and under utilised.

Seventy percent of the growers surveyed in the 1964 study financed operations out of current earnings, and this suggests that production plans change considerably.

Enting et al (1965) assert that the plans which are made as a result of price instability may tend to perpetuate instability. If prices are high and gross earnings are high it seems plausible that finance will be used to produce more of the high priced crop for the following season. Resources may be wasted because the marginal revenue may be greater from an alternative use of these funds, especially since the price is likely to fall when the resulting increase in production arrives at the market. Alternatively, when prices are low, planting may be cut back and investment reduced in what may be a growth product.

Rae (1976) asserts that instability obscures price trends and that this might subvert the efficiency of price as the director of economic resources. He also notes that price instability can result in over diversification.

#### 4. Explanations of Price Instability

In the 1964 study of the fresh vegetable industry, Enting et al found that a third of growers reported withholding production from the market because of low prices. This points to overproduction as a possible cause of price instability.

However, in the same study the researchers concluded that there was no evidence to suggest that extreme overproduction was a major problem in the industry. ".the panel is of the opinion that instability of output and prices poses a much more serious problem for the industry than does overproduction" (Enting et al 1965, page 71).

At that time no downward trend in retail or auction prices was found among the vegetables studied. If this had been the case, it may have been that long-run supply was expanding at a greater rate than long-run demand.

Yet in a follow-up study Philpott and Bourke (1971) found that in general, from 1957/58 to 1968/69 vegetable production had increased while prices at wholesale had remained at about the same level. Using data mainly from Auckland markets, they found that auction prices of cabbage fluctuated more than for cauliflower, carrots, onions, or tomatoes. Sometimes cabbage prices at auction fluctuated by as much as 280 percent.

The table below indicates that in the five years to 1981 vegetable production increased in each successive year. More recent figures were not available.

-----  
 Table 1 Total vegetable production 1977-1981  
 -----

	year ended March 31				
	1977	1978	1979	1980	1981*
gross production output value (\$ million nominal)	62	87	111	142	168
index of production volume output 1972 = 1000	884	1064	1091	1184	1204
index of production value	62	89	112	142	168
* provisional					

-----

source New Zealand Official Yearbook 1983 pp 402-3.

Carson (1986) asserts that increased production has been necessary to maintain incomes. He claims that the industry is more concerned with improving efficiency and productivity (of existing lines) than with exploiting new opportunities. He cites tomato growers as examples of this "production - led" attitude.

Fluctuating supply levels are also identified as a probable reason for the wide variations in wholesale prices. Unstable supply supposedly leads to inefficient capital use and sometimes the need for emergency finance.

It is also, according to Enting et al (1965), responsible for unnecessary movement of firms in and out of horticulture, and loss of labour, manure, fuel, and use of land.

Carson (1986) comments that consumers' tastes have "widened from the restricted British conception of fresh food." Vegetables are being supplied to market which were not available commercially until recently. These include courgettes, capsicums, sprouting brocolli, and spinach.

He also asserts that tastes are no longer tied to a particular season, and many vegetables are now available throughout the year. This is probably true of tomatoes, lettuce, capsicum, spring onions, cabbage, cauliflower and others. The use of new varieties of vegetables means that it is now possible to extend seasons and to increase yields. Lettuces were once a summer vegetable only. Now they are available all year.

To maintain viability in light of these consumer trends, and more aggressive retailing, growers have improved productivity and have invested in new production methods. But according to Carson real returns from fresh vegetables are declining.

## 5. Growers' Response to Price Instability

Not only are farm price fluctuations seen as undesirable by growers, but also growers appear ill-equipped to take preventative measures in an attempt to reduce the risk involved.

Enting et al (1965) reported that for onions growers did not know that the peak or trough price had been reached and that it took some time for them to react. Interestingly, production of onions was still rising after a history of falling prices between, among other periods, 1956 and 1958.

It seems that most growers only perceive variation within a short time period, perhaps a week or a month. Perhaps they are not clear about the behaviour of prices over a longer period to time. This suggests that growers do not really know much about the seasonality of prices. They certainly are aware of the seasonality of production.

Yet, wholesale prices can be very useful to growers. In the short term they enable growers to decide how much to harvest and, sometimes, which competing market to sell in. If the grower has a choice between regional markets, or if he has the option to sell direct rather than on the auction floor there may be occasions when it is more profitable to do so.

In the longer term, prices help the grower decide his product mix and the level of investment. It would be foolish to invest heavily in pest destruction, for example, if the price of the affected crop was relatively low.

Cochrane (1958) notes that the full impact of retail price changes is felt at the producer level rather than at later stages in the distribution chain because of the fixed nature of marketing costs and margins. Yet growers have taken few steps to reduce the power of retailers over price formation.

The New Zealand Vegetable and Produce Federation (Inc) has acted on behalf of growers in an attempt to improve their influence on prices. Its activities have included lobbying retailers to discourage direct buying, stimulating primary demand at the consumer level through advertising, and research into vegetable marketing. This, however, is the only attempt to act collectively, and most growers' incomes are determined by their independent decisions.

Cochrane (1955) discusses the role of price uncertainty in production decisions. Growers are always uncertain of the prices which will be received for their crops at a future time. He notes that in seeking to minimise risk, growers will restrict the production of crops for which prices are very uncertain. Further, he asserts that new production methods and technology which require considerable resources will be adopted more quickly when prices are certain than when they are uncertain.

Rogers (1970) comments that supply is likely to be more uncertain in industries which are not very concentrated, which have generally undifferentiated products, and to which entry is not very restricted. This is largely due to fragmented decisions about output.

Not only are production decisions fragmented but also harvesting decisions are fragmented. Many growers might put forward or delay harvesting due to price conditions, which may contribute to price instability.

Finally, a grower might seek to increase revenues by supplying markets other than the local auctions. Additional transportation costs must be considered, but the higher price obtainable due to shortages may still make a distant market more attractive. Where many growers follow this option price instability will be caused.

Enting et al (1965) assert that in total, consumers and growers will not benefit from this so called "market chasing", since it may worsen price instability. They claim that for the majority of growers, it would be uneconomical to transport perishable production to distant markets. This practice is common in the 1980s, although not necessarily economical. Enting et al believe that any redistribution between regional markets should only be undertaken by auctioneers and large growers, for whom it might be profitable. Indeed auctioneers do act in this way to alleviate regional surpluses and shortages.

## 6. Summary

It is clear that vegetable prices are uncertain and subject to considerable instability. This affects production plans, incomes, cash flow, rates of return, and the adoption of new technology by growers.

Growers are faced with making production, harvesting and supply location decisions under great uncertainty, and appear to make little use of wholesale price and other data to reduce this uncertainty.