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THE DEMAND FOR PEAS AND BEANS IN THE SYDNEY MARKETS

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Peas and beans are probably the most important vegetable, both in value and in quantity, traded at the City of Sydney Markets. This analysis attempts to show the fluctuations in supply and relevant changes in price which have occurred since 1955.

It was found that the price of peas was correlated to their supply. Since 1955, the supply-price curve seems to have shifted downward slightly, despite rising costs of production and a decrease in the real value of the income pound of the grower. This is all the more remarkable as the number of consumers increased during this period. The evidence that this really occurred, however, is not conclusive.

In the case of beans no definite relationship between price and supply could be established. Only when the figures for the winter months (June, July and August) were treated separately, did it become possible to determine a correlation between these variables.

It is worth noting that the "short run" curves, based on weekly data and covering from one to two winters, are much flatter than the curve which represents the data of all winter months from 1955 to 1959 and which is calculated from annual averages. The supply of beans increased considerably over these years and the difference in slopes between these curves suggest not only an adjustment to the increased supply, but also a weakening in demand due to other causes.

It was further found that a close relationship existed between the prices of beans and peas, so that, during the period 1955 to 1959, an increase of, say, 10 per cent in the price of peas, was accompanied by an increase in the bean price of almost 9½ per cent.

Although an attempt was made to introduce a further variable in the form of the price of a "basket" of selected vegetable it proved impossible by partial or multiple correlation analysis, to obtain significantly higher correlation coefficients for the price and supply of beans, although the correlation between the price of this "basket" and the price of beans or peas was highly significant.

The apparent decline in the levels of pea and bean prices does not, as yet, appear serious. It is impossible to say, however, whether or not this downward trend will continue. If it does, particularly under inflationary conditions, the growers' real income will be seriously affected.

The Data

The prices used have been collected in the City of Sydney markets by officers of the Division of Marketing and Agricultural Economics of the New South Wales Department of Agriculture. A weighted average price is calculated daily, the weight depending on the officer's impression of the prices at which most sales were made. From these weighted daily averages

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a weekly mean is calculated, which has been used in this analysis for determining "short run" curves. "Long run" curves have been calculated from the geometric annual means of the weekly prices.

The supply figures are collected daily by a number of agents, who make these figures available to the markets officers. These figures have to be treated with the utmost care, as they refer to arrivals in the Agent's section of the markets only, whilst the supply in the Growers' section represents an unknown quantity. This is probably not so important in the case of peas, as only a relatively small quantity is traded in the growers' market. In the case of beans, however, at certain times of the year considerable quantities are offered by growers from the near-Metropolitan area. Throughout, the supply has been measured in terms of "bags". This may be somewhat ambiguous as during the winter months some beans arrive in cases. The contents of these cases, however, do not differ much from the average "bag", which contains roughly 60 lb. of beans or 70 to 85 lb. of peas.

The recorded supply of peas and beans is subject to strong seasonal fluctuations, as is shown in Fig. 1. With peas, the period of heavy supply falls in Summer, when vegetables generally are well supplied and prices are below the yearly average.[1] To some extent the close negative correlation between the price and supply of peas is evidence of the general movement

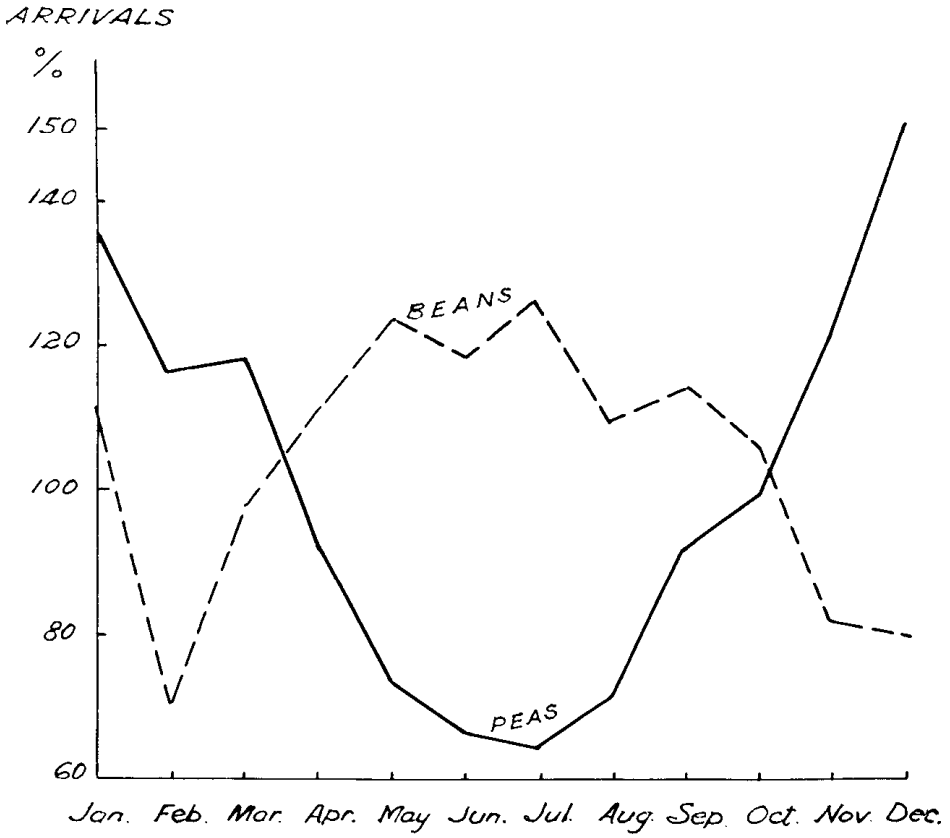

Fig. 1. Seasonal Fluctuations in the Recorded Supply of Peas and Beans at the City of Sydney Markets, 1954 to 1959

[1]Cf. "Some Economic Aspects of Vegetable Marketing", this *Review*, Vol. 26, No. 1 (March, 1958).

of prices in the market. This fact is brought out strongly in the case of beans, where the peak supply coincides with the winter-high-price period, so that we can observe the apparent paradox that at a period when bean supplies are increasing, the price moves up also, so that a positive, albeit a very low, correlation between the price and supply of beans is found. The fact that the general price level of vegetables rises during Winter is, however, only true in broad terms, and it is impossible to prove this statistically with the help of the, no doubt very deficient, price level of the "basket".

The analysis covers a period from January, 1955, to September, 1959, inclusive; whenever 1959 is denoted, this covers only part of that year. The work is based on weekly data and, unless otherwise stated, N = 247. The data were processed in logarithmic form and the following symbols have been used:

1 Y_b price of beans
2 Y_p price of peas
3 X_b supply of beans
4 X_p supply of peas
5 Z price level, selected vegetables (a further definition is given below).

(*e.g.*, r_{13} represents the correlation coefficient between price and supply of beans).

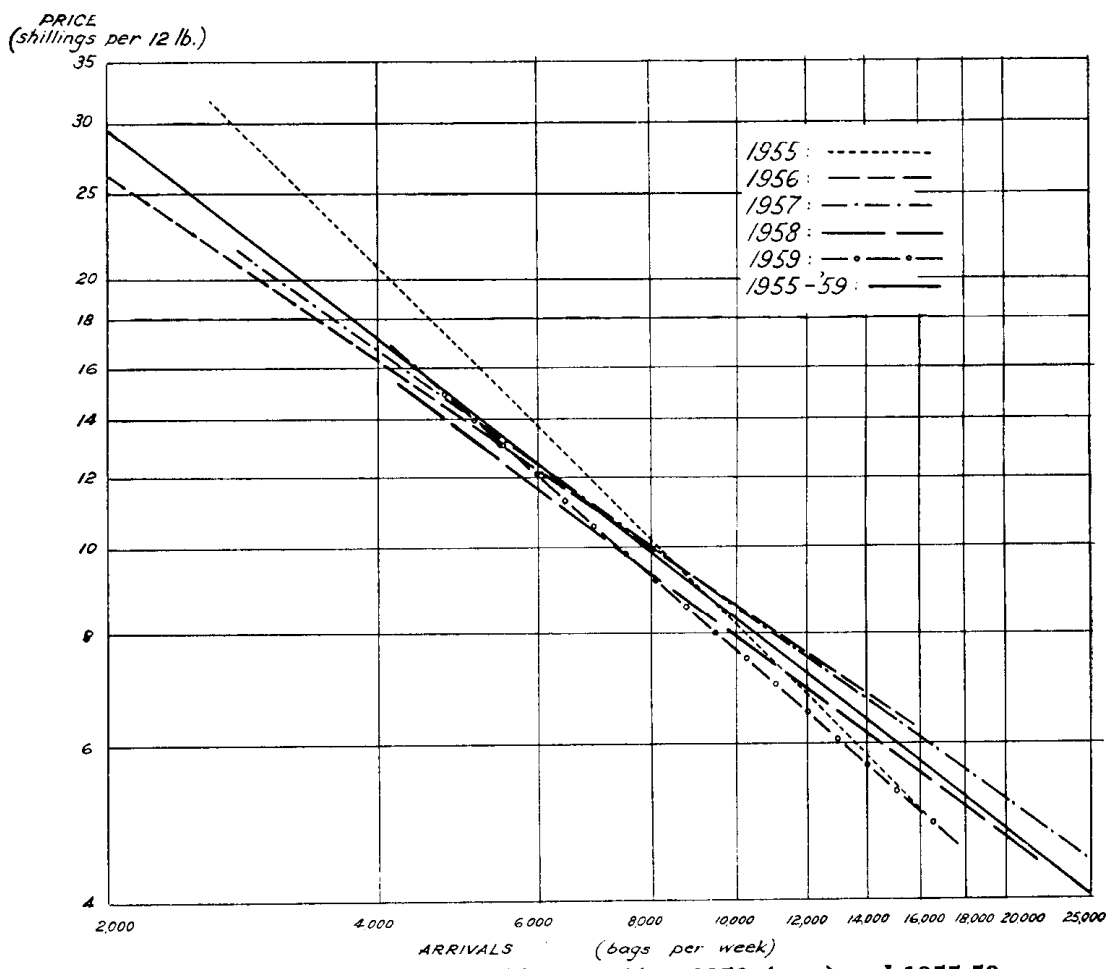

Fig. 2. Price-supply Curves of Peas 1955 to 1959 (part) and 1955-59

Peas

If all the data for the entire period are combined together we obtain an equation which represents the relation between the supply and price of beans as follows:—

$$\text{Log } Y_p = 4.0527 - 0.7852 \log X_p; \; r_{24} = -0.819.$$

This appears satisfactory as the correlation coefficient is highly significant. However, if the data are split up in annual groups, some less satisfactory aspects appear from a statistical point of view. The following equations represent each of these years; the curves, together with the combined curve for the entire period, are represented in Fig. 2.

1955: $\log Y_p = 4.9747 - 1.0175 \log X_p; \; r_{24} = -0.825.$
1956: $\log Y_p = 3.7495 - 0.7051 \log X_p; \; r_{24} = -0.878.$
1957: $\log Y_p = 3.8221 - 0.7230 \log X_p; \; r_{24} = -0.819$
1958: $\log Y_p = 3.9363 - 0.7600 \log X_p; \; r_{24} = -0.844$
1959: $\log Y_p = 4.4297 - 0.8869 \log X_p; \; r_{24} = -0.722.$

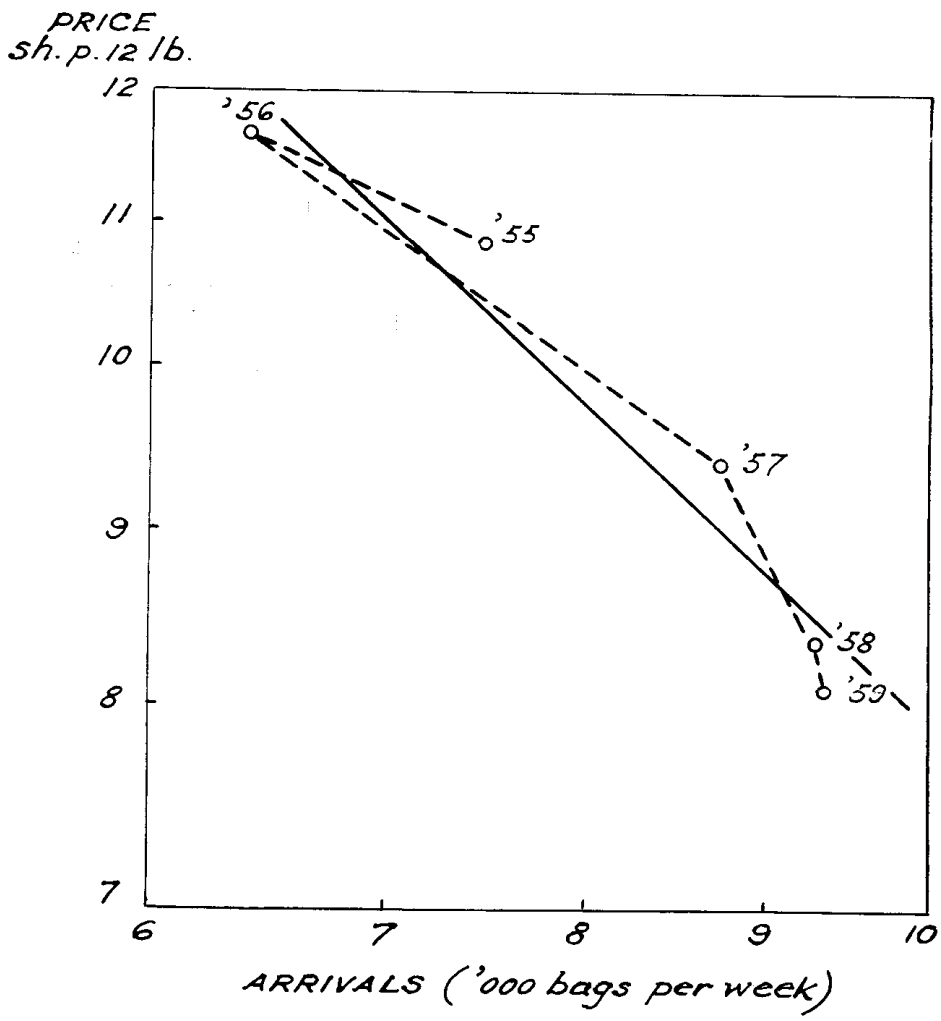

Fig. 3. Yearly Geometric Means of Weekly Supplies and Prices of Peas 1955-59 and "Long Run" Price Curve

When the data of these five years are subjected to Bartlett's test[2], it is found that $\chi_4^2 = 16.004$ and we therefore cannot accept their homogeneity. A covariance analysis, further comparing these five years, show that both the slopes of the individual year curves and the distances between the curves differ significantly as the following result shows.

	df	*Mean squares*	*F*
Ascribable to regression ..	1	7.4486	
Differences in regression coefficients	4	0.0398	2.93
Distances between regressions	4	0.0664	4.88
Unaccountable	237	0.0136	

The 5 per cent level of significance with 4 and 237 degrees of freedom is at 2.40. Combining the individual year curves into one overall curve and assuming that this overall curve represents the data as satisfactorily as the five separate curves, is not, therefore, warranted from a statistical point of view.

Another point may be noted here. When Fig. 2 is considered it appears as if the supply-price curves have shifted downwards gradually in time and that therefore demand has decreased over time. This may well be the case, but does not necessarily follow. In Fig. 3 the geometric means of weekly prices and supplies have been plotted for each year and a "long-run" curve calculated from these annual averages has been drawn through these. It may be noticed that, whilst, since 1956 prices have moved downwards, supplies increased simultaneously. Furthermore, a decrease in supplies in 1956 from the previous year was accompanied by higher prices, despite the fact that in Fig. 2 over most of its length the 1956 curve lay below the one of 1955. Whether or not a shift in the supply-price curve represents a shift in demand will be discussed later.

Beans

No significant correlation can be established between the supply and price of beans, either when we consider the material for the period as a whole, or when this is split up into individual years. This is not surprising, for, as has been pointed out above, the arrival figures may be biassed, particularly during the Summer, whilst movement in the price level of vegetables in general will disturb the relationship even more.

A somewhat better result is obtained by isolating the data for the winter months, June, July and August. All data for these months over the five-year period provide us with a curve of which the equation is:—

$$\log Y_b = 5.2498 - 1.0484 \log X_b; \; r_{13} = -0.770\,^{3}.$$

Whilst the material appears to be homogeneous, a covariance analysis shows that there is a significant difference between the distances of the curves, although the slopes did not differ significantly.

	df	*Mean squares*	*F*
Ascribable to regression ..	1	1.4903	
Differences in regression coefficients	4	0.0182	1.67
Distances between regressions ..	4	0.1044	9.58
Unaccountable	54	0,0109	

The 5 per cent point for 4 and 54 degrees of freedom is at 2.54.

[2] Cf. George W. Snedecor, *Statistical Methods* (Ames, Iowa: The Iowa State College Press, 1940), pp. 206-207.

[3] N = 63.

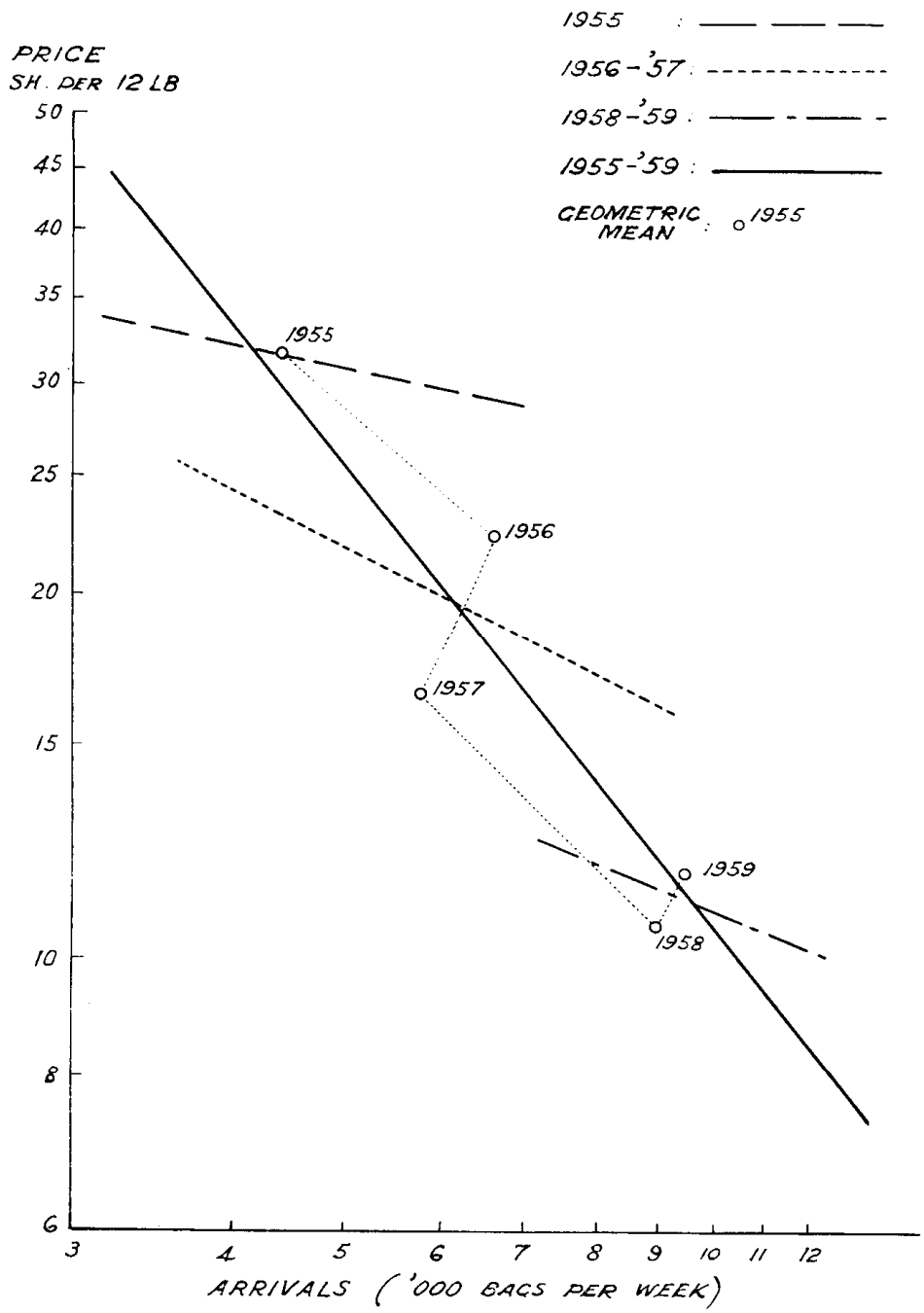

Fig. 4. Winter Demand for Beans. "Short Run" Curves for 1955, 1956-57 and 1958-59; (Geometric) Means of Prices and Supply for Each Year 1955-59, and "Long Run" Curve

When the data are plotted on a scatter diagram the points cluster in three groups, one for 1955, the second for 1956 and 1957 and the third for 1958 and 1959. Curves could be drawn through these clusters as shown in Fig. 4. The slopes of these "short run" curves are much flatter than that of the curve which has been calculated from annual averages and which is also shown in Fig. 4. The equation of this "long run" curve is:

$$\log Y_b = 6.0762 - 1.2634 \log X_b.$$

"Long" and "Short Run" Demand Curves

It may be opportune to consider here some of the problems which arise when in an analysis of this type, the time factor becomes important. The terms "demand" curve and "supply-price" curve have been used as interchangeable. This, of course, is not serious as long as no confusion can arise regarding their meaning. Strictly speaking, the definition of "demand" does not allow a time factor to enter; it concerns the relation between supply and price at one particular moment, that is the price which buyers are willing to pay at a certain time for various quantities supplied. This *ceteris paribus* assumption, however, must be relaxed in any practical application of demand theory, even to such an extent that we not only compare prices and supplies during equal time periods, but that we also consider the relationships during periods of different length, *i.e.*, a comparison of "short run" curves, here calculated from weekly averages and a curve calculated from annual averages, which here is called a "long run" curve.

The comparison between the "short" and "long run" supply-price curves, if plotted on double logarithmetic scale, revolves around a comparison of their slopes. This is so because any interpretation of different prices over a period of time will resolve into a question of causality and then two extremes are open.

(i) The difference in price can be explained wholly by differences in supply. This admits two further extreme possibilities:

- (*a*) only changes in supply and price occur and a change in price is directly caused by a change in supply;
- (*b*) changes in supply have a "long run" indirect effect.

(ii) The differences can be explained wholly by external factors which would have operated even if no changes in supply had occurred.

In (i) (*a*), the "short run" curves coincide with the "long run" curve (a and a′ in Fig. 5). A change in price from p to p′ can here be fully explained by a change in supply from q to q′.

The graphical representation of (i) (*b*), however, will look similar to (ii) and only a knowledge of the nature of the particular commodity and buyers' behaviour towards it may help to decide what has happened. In Fig. 5 the fall in price from p to p″ occurred when the quantity increased over time from q to q′. This might have been due to an adjustment of consumers' taste to the increased supply, to technical innovations which make it possible to utilize the increased supplies, or similar developments as in (i) (*b*). However, the fall in price from p to p″ might just as well have occurred as a result of factors which were quite unrelated, e.g. a change in income, or in the purchasing power of money or any other external factor as in (ii). In both cases ((i) (*b*) and (ii)) the elasticity of the "short run" curves (and

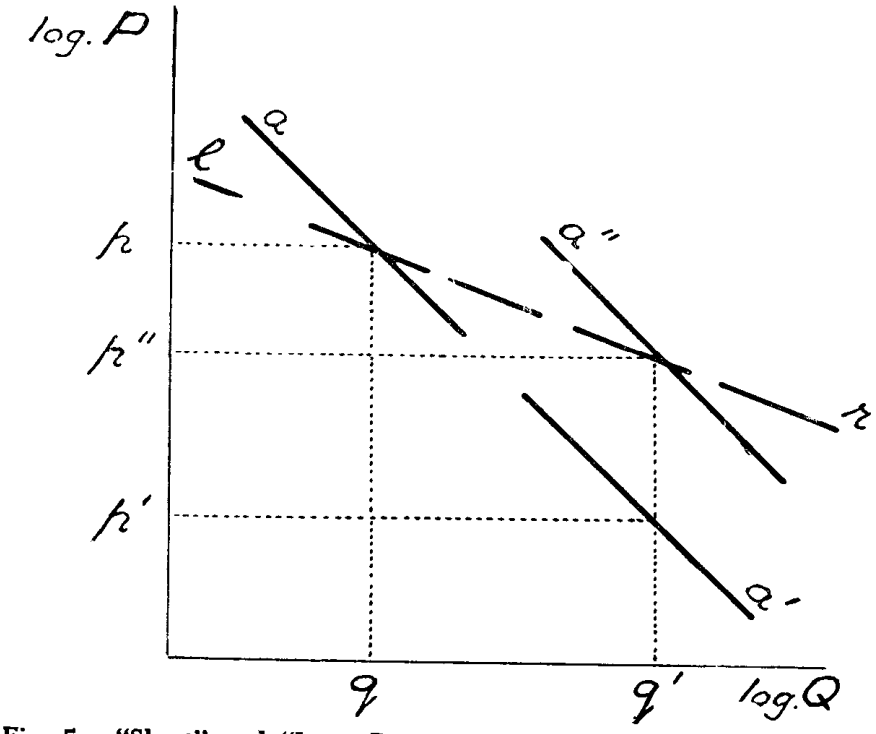

Fig. 5. "Short" and "Long Run" Demand Curves, with Identical and Different Elasticities

a″) will differ from the elasticity of the "long run" curve (1r). Although the "long run" curve in case (i) (*b*) is identical with the one representing case (ii), in the latter case the curve is little more than a co-ordinating chasing "short run" curves over the graph in, possibly, a quite haphazard manner.

In what way, then, can we explain the "long run" curve in Fig. 4. If, on the basis of our knowledge of the market and the particular commodity, case (i) (*b*) is excluded, then the difference in elasticity between the "long" and the "short run" curve must be explained in terms of external factors. If this is so, what has happened can then be described as a weakening of demand, as, at a certain period, for an identical quantity supplied, a lower price than during a previous period is obtained.

Can we exclude (i) (*b*) or at least assume that it played an unimportant role? In the case of a perishable vegetable we may generally expect that with increasing supplies the "short run" curve will be, at least, equal to or steeper than the "long run" one. This is not the case here where the "long run" curve is steeper than the "short run" ones. This steepness cannot be explained satisfactorily on the basis of our knowledge of the market alone and, therefore. we must assume that indeed to a certain extent a "weakening of demand" has occurred. This is the more remarkable because population has increased and money income has also risen during the period. A few tentative reasons can be put forward to explain the decline in price levels. There was an increase in the supply of canned and bottled peas and beans over this period. In 1954-55 Australian production of these amounted to approximately 7,000 tons, in 1957-58 this figure had risen to 17,000 tons. In addition, during this last year almost 6,000 tons of quick frozen peas and beans were produced. (No figure for 1954-55 is available).

Furthermore, although no satisfactory data are available, it is suspected that retail margins have increased during these years and that retailers have been successful in commanding at least part of the increase from the growers.

As yet the growers who supply the market with beans during the winter do not seem to be worried unduly by the drop in prices. In discussion with a number of growers it became evident that at the present price, production of beans during the winter was still profitable and that they regarded the price levels of previous years as abnormally high.

In the case of peas it appears that a similar thing has happened. The slope of the five "short run" curves combined was, as set out above, —0.7852, whilst the slope of the curve, calculated from annual averages, is —0.9310. The difference in slopes is here not so pronounced.

Relation Between Peas and Beans

The price of peas and beans appear to move together to quite a considerable extent. If all data are combined, this relation between the prices of these two commodities can be expressed by the following equation and is graphically represented in Fig. 6.

$$\log Y_b = 0.1035 + 0.9416 \log Y_p; \; r_{12} = 0.776$$

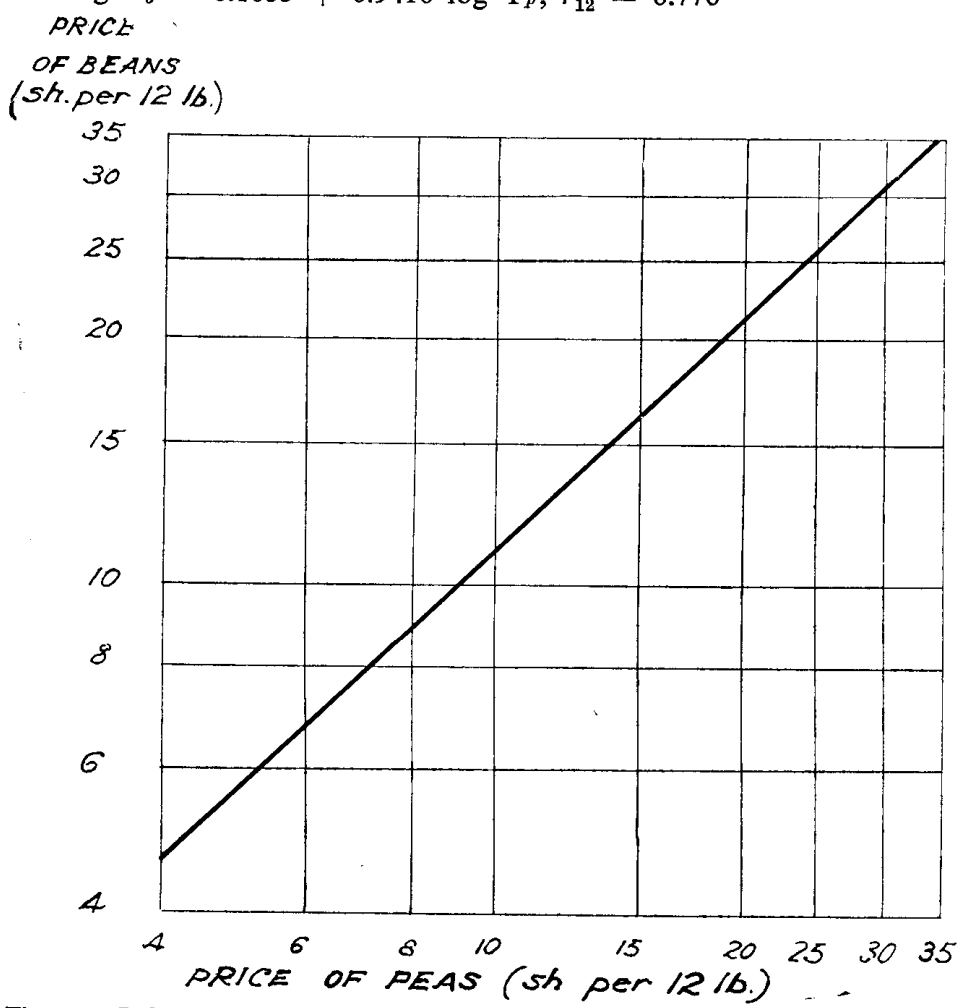

Fig. 6. Relation between the Price of Beans and Price of Peas, 1955-59

A similar relationship can be established between the price of beans and the supply of peas, where

$$\log Y_b = 3.5904 - 0.6551 \log X_p; \; r_{14} = -0.563$$

These two equations may be combined into one as follows:

$$\log Y_b = -1.1137 + 1.1606 Y_p + 0.2563 X_p; \; R = 0.786$$

It is at this stage, of course, rather tempting to interpret this material in terms of cross elasticities. It could be said, for instance, that a 10 per cent change in the supply of peas causes a change in the price of beans of some 6.5 per cent. It would be quite impossible, however, to prove that the change in the price of beans was indeed caused by the change in pea supplies and not by other factors, e.g. the price of other vegetables, which may, and indeed to some extent seem to move in a parallel seasonal fashion.

If we isolate the data for the winter months, however, this objection loses at least part of its validity. For this period it is also found that prices of peas and beans are closely correlated as follows:

$$\log Y_b = -0.2026 + 1.2144 \log Y_p; \; r_{12} = 0.879$$

Furthermore a highly significant correlation exists also between the price of beans and the supply of peas:

$$\log Y_b = 4.4194 - 0.8511 \log X_p; \; r = -0.662$$

Some Further Considerations

It is possible to introduce another variable, namely the price of a "basket" of vegetables, containing cabbages, tomatoes, beetroot and spinach. The choice of vegetables in this "basket" is determined by the availability of suitable data, a course of action which is hardly conducive to satisfactory results. A further difficulty is the weighting problem. Lacking all information about the supply of these vegetables, it is impossible to determine weights in any way which would conform to even the most elementary requirements of statistical accuracy.

Nevertheless, such an analysis, however crude, may be useful, if we keep its limitations in mind.

It is found that there exists a significant correlation between the price of beans and the price of the "basket" as follows:

$$\log Y_b = -0.1156 + 0.6599 \log Z; \; r_{15} = 0.529$$

This relation is for the price of peas:

$$\log Y_p = 0.2013 - 0.4509 \log Z; \; r_{25} = 0.439.$$

When we calculate the partial correlation coefficients it appears, however, that the introduction of the "basket" has contributed only little. The correlation between the supply and price of beans, holding the "basket" constant, becomes 0.018 (still not significant) and the correlation for the same relation of supply and price of peas, $r_{24.5} = 0.818$. The result of the introduction of this "index" is disappointing. It is suspected, however, that the lack of results is mainly due to deficiencies of the material and that in fact there exists a considerable affinity between the price levels of various vegetables.