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RESEARCH UNIT



Lincoln College

SOME PROJECTIONS OF  
RETAIL CONSUMPTION  
IN NEW ZEALAND

by

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## THE AGRICULTURAL ECONOMICS RESEARCH UNIT

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by

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## P R E F A C E

The marketing research programme of the Research Unit is concerned with formulating forecasts and projections of demand for New Zealand agricultural export products in our major markets. A forecast of demand for a commodity requires first a careful and precise econometric analysis of the effects on consumption of the commodity of changes in its price and in the price of other substitute commodities.

As a contribution to the methodology of demand forecasting, R.H. Court has developed methods of estimating such demand relationships, for groups of commodities, in which the relationships are consistent with the economic theory of demand. These methods are reported in detail in AERU Technical Paper No. 1, "An Application of Demand Theory in Projecting New Zealand Retail Consumption".

This publication represents a more popular version of the Technical Paper and lays emphasis rather more on results than methods. In this case the results are concerned with short run forecasting and long run projections of changes in retail trading in New Zealand, using the sample retail trading figures published by the Department of Statistics.

Projections of retail trading will of course be of interest in their own right but the results are also important ingredients in the work being done by the Research Unit on future projections of the structure of the New Zealand economy.

B. P. Philpott

Lincoln College,  
November 1966

## 1. INTRODUCTION

The object of this paper is to investigate some factors influencing the level of sales from retail stores in New Zealand and to give some projections of possible future levels of sales in five years and ten years from the present. Some forecasts for certain retail groups in 1966 are also attempted, providing a means whereby the method and results can be quickly tested against observed reality.

Retail trading forms an important sector of the New Zealand economy and so any knowledge of the likely future course of sales should be of great value to those interested in New Zealand economic policy, as well as to those who are directly interested in retail trading itself.

The main results set out in this paper are in the form of numerical estimates rather than broad qualitative verbal conclusions. The former are more difficult to produce and easier to prove wrong than are the latter, but are more valuable in that they contain more information and provide a sound and consistent framework on which to base further qualitative or quantitative conclusions.

The projections given are for a selection of retail commodity groups as well as for total retail trading.

The individual groups chosen have been called

- (1) meat
- (2) other foods
- (3) apparel
- (4) household operation
- (5) miscellaneous

and together these make up total retail trading. The reasons for choosing these particular groups and the items

included in them are explained in an appendix. It would be quite possible to explain retail trading using a finer commodity breakdown than these rather broad groupings but, unless more detail were specifically required, there is little point in achieving a finer breakdown in a study as general as that undertaken here.

Regarding the layout of the paper, it is thought desirable to explain firstly just what is meant by the term "projections" in the particular context used here. Next, factors affecting the level of retail sales are considered and numerical estimates of the quantitative influence of these factors are obtained. These estimates are then used together with assumptions about the future levels of the influencing factors to obtain projections of New Zealand retail sales for 1966, 1970 and 1975.

## 2. THE NATURE OF PROJECTIONS

The term projection in the sense used in this paper, refers to a looking ahead or a statement about the possible future course of some event or events under certain prespecified conditions.

A projection in this sense differs from a prediction in the same sense that a conditional statement differs from an unconditional statement. A prediction, as an unqualified statement about some future occurrence, is evidently very chancy and cannot in general be given with any known degree of accuracy. A projection, as a statement about some future event that is dependent on other known (or assumed) events, can be given with a known degree of accuracy depending on the precision of the relationship between the known events and the event to be projected.

To produce projections of the future levels or values taken on by economic variables, it is therefore necessary to have a theory or model explaining why these variables take on the particular values that they do, whence the construction of projections presents no great logical problem.

It is not hard to think of examples illustrating the practical importance of such projections or conditional predictions. A politician, for instance, may wish to compare next year's national income if he reduced the income tax rate by 5%, with the national income which would eventuate if he increased the income tax rate by 5%, all other things being equal. Even if he does neither of these things (he obviously cannot do both at once), an answer to the question "what would happen if.....?" would

be of great assistance in enabling him to choose the most desirable course of action.

The purpose of this paper is to give some projections of New Zealand retail trading and a prerequisite to this is to have some model or theory explaining why the New Zealand purchasing public spends its money as it does on the various groups of retail items. The development of a theory with this aim in view is explained in the next section.

### 3. EXPLAINING RETAIL CONSUMPTION

Any theory explaining retail consumption over time periods long enough to be useful for projection work implies the existence over such periods of stable response patterns in human beings to changes in their environment (in the case of retail consumption at least). It is possible that the existence of such patterns of human behaviour could be the subject of some philosophical discussion. We can only say here that, although individual behaviour may vary widely, in large groups individual differences tend to cancel out and the behaviour of human populations tends to be reasonably stable and predictable. In the field of economics, a very large number of statistical investigations has provided evidence of response patterns stable enough to be useful for purposes of policy and prediction or projection.

To explain why people spend their money as they do, economists generally begin with the proposition that a person purchases items because he obtain satisfaction,

enjoyment or utility from using them. In general, the more of any item he can purchase the greater is his satisfaction. But most people are limited in their purchasing possibilities by having only a limited income or limited amount of money available for spending and this fact must be taken into account when attempting to determine the amount of each item which a consumer must choose if he is to attain a state of greatest satisfaction.

From these two propositions of desire for greatest satisfaction on the one hand and limited income on the other hand, it is possible to derive certain more useful propositions concerning the observable market behaviour of the purchaser. Firstly the individual or group concerned will adjust purchases of quantities of each item according to relative prices of all items and according to real income. Certain non-economic influences may operate also, some of which will be considered later. This first statement may or may not be intuitively obvious as an explanation of market behaviour, but its derivation from more basic principles leads to the second statement that if the purchaser is to stay in a position of greatest satisfaction when prices and his income change, then the extent to which he substitutes commodity A (say) in his purchases for a different commodity B, is related in a direct and essential way to the extent to which he substitutes commodity B for commodity A. This second statement also may or may not be intuitively obvious as a general principle, but the exact nature of such substitution relationships can be obtained only by a somewhat complicated mathematical and logical argument which can be found in advanced textbooks on economic theory but is not reproduced here.

To produce projections of retail consumption it is not sufficient merely to determine which factors influence consumption, but it is also necessary to find out the quantitative or numerical effects of these factors, i.e. to answer the question "by how much?". Unless outside knowledge is available, and it is not in the case under discussion here, the only way in which this question can be answered is by using statistical techniques, whereby information or data on how the purchasing public has behaved in the past is used together with the assumption of stable behaviour over time to obtain response patterns for retail consumers expressed in quantitative or numerical terms, whence projections for the future can be readily obtained under appropriate assumptions about the levels of prices, income etc.

To use statistical methods for this purpose, we need numerical data on the relevant activities and a mathematical formulation or set of equations representing the theory explaining retail consumption. The sources and derivation of the required data are given in an appendix to this paper and the mathematical formulation of the set of demand equations explaining retail consumption is explained in the following section.

#### 4. RETAIL DEMAND EQUATIONS AND THEIR MEANING

A form of demand equation that has been much used in the past to express stable consumption behaviour is the linear logarithmic equation which, in the very simple case where demand  $q$  for a commodity is determined entirely by the price  $p$  and income  $M$ , can be written

$$\log q = a + b \log p + c \log M$$

where  $a$ ,  $b$  and  $c$  are the constants of the equation, that is, the elements of consumer response to changes in price and income that remain stable over time.  $b$  and  $c$  can further be interpreted as demand elasticities, whereby we can make the statements that if price changes by one per cent and income remains unchanged, then consumption will change by  $b$  per cent, and if income changes by one per cent, price remaining unchanged, then consumption will change by  $c$  per cent. Generally an increase in price is associated with a decrease in consumption and an increase in income is associated with an increase in consumption, implying that  $b$  is a negative number and  $c$  a positive number. If  $a$ ,  $b$  and  $c$  are known, then any given values of  $p$  and  $M$  allow us to determine the quantity demanded,  $q$ , by substituting in the above equation.

The explanation, as given in this paper, of the demand for New Zealand retail commodity groups follows the basic pattern indicated by the above equation but is rather more complicated. As there are five commodity groups considered we must have five equations, explaining the logarithm of demand for each group in terms of the logarithms of relative prices of all five groups and in terms of the logarithm of

real income.

The theoretical considerations underlying this explanation of demand refer to a single purchaser whereas the available data on retail trading refers to New Zealand totals. This aspect is handled by explaining demand or consumption per head in terms of relative prices and real income per head, thus bringing population figures into the equations somewhat indirectly.

Published New Zealand retail statistics are in quarterly figures and we may expect seasonal fluctuations in demand that can not be explained by variations in prices and income. Thus there is higher icecream consumption over the summer months, generally greater retail sales during the Christmas shopping rush etc. Seasonal effects of this nature are handled by including seasonal "dummy" variables in the equations which take on the value of one when any season occurs, e.g., the winter months, and are zero at other times. As all other variables in the equations are in logarithmic form, the assumption thus made about the nature of seasonal variation is that, if all prices, income and population are unchanged then consumption of any commodity group in the quarter ended March (say) is a constant proportion of consumption of the same group in the quarter ended December (say), and similarly for each other season.

Using the data whose derivation is given in the appendix, the constants of the five retail demand equations were estimated using the statistical method of maximum likelihood. All of the considerations mentioned above are embodied in the estimated equations, that is, the dependence of the logarithm of consumption per head of each

commodity upon the logarithms of relative prices of all commodities, the logarithm of real disposable income per head and the dummy seasonal variables. The symmetrical substitution relationships between commodities, mentioned in section 3 and which must hold if a stable consumption pattern is to be adequately explained, are also incorporated in the numerical results which are given in the table.

The various items and entries in the table are explained as follows.  $Q$  represents the logarithm (or log.) of consumption per head (of the appropriate commodity group),  $P$  is the log. of relative price,  $M$  is the log. of real income per head and  $S_1$ ,  $S_2$  and  $S_3$  represent the three-monthly periods (or seasons) ending 31st March, 30th June and 30th September respectively. Seasonal variation during the three months ended 31st December is included in  $const.$  which denotes the constant term in each equation.

The numerical entries under the  $P$ 's and  $M$  are demand elasticities and a knowledge of these allows us to make statements of the following type. "If the relative price of meat,  $P_1$ , increases by one per cent, all other prices, income per head and season remaining the same, then it is our estimate that the consumption per head of meat will fall by .72%, other food will fall by .06%, apparel will increase by .36%, household operation will fall by .01% and miscellaneous will increase by .03%." Similar statements can be made regarding the numerical entries under the other four prices. Likewise, if real income per head rises by one per cent, everything else remaining the same, then meat consumption per head will rise by .03%, other food by .31%, apparel by .22%, household operation by .56% and miscellaneous by .81%.

		P <sub>1</sub>	P <sub>2</sub>	P <sub>3</sub>	P <sub>4</sub>	P <sub>5</sub>	M	S <sub>1</sub>	S <sub>2</sub>	S <sub>3</sub>	Const.	R <sup>2</sup>
Meat	Q <sub>1</sub>	-.72 (.08)	-.12 (.09)	.70 (.09)	.03 (.13)	.23 (.17)	.03 (.06)	-.09 (.01)	-.03 (.01)	-.01 (.01)	1.104	.91
Other food	Q <sub>2</sub>	-.06 (.03)	-.87 (.07)	.10 (.05)	-.03 (.08)	.36 (.11)	.31 (.06)	-.09 (.01)	-.10 (.01)	-.08 (.01)	1.272	.94
Apparel	Q <sub>3</sub>	.36 (.05)	.17 (.08)	-.59 (.13)	.26 (.14)	-.02 (.18)	.22 (.08)	-.24 (.01)	-.04 (.01)	-.20 (.01)	1.103	.95
House op.	Q <sub>4</sub>	-.01 (.10)	-.13 (.18)	.35 (.22)	-1.90 (.40)	1.93 (.49)	.56 (.15)	-.20 (.02)	-.13 (.02)	-.12 (.02)	-.272	.90
Misc.	Q <sub>5</sub>	.03 (.05)	.26 (.09)	-.08 (.11)	.78 (.19)	-1.88 (.32)	.81 (.10)	-.18 (.01)	-.15 (.01)	-.17 (.01)	-.473	.91

The numerical entries under  $S_1$ ,  $S_2$  and  $S_3$  have slightly different meanings and allow us to make statements of the following type. "If all prices and income per head are unchanged then meat consumption per head in the March quarter (to which  $S_1$  refers) stands in the proportion of  $e^{-.09}$  or .91 or 91% of meat consumption per head in the December quarter."  $e$  is a symbol denoting the number 2.7183, which is the base of the logarithms used. Calculating similar proportions for the other commodity groups in the March quarter we have  $e^{-.09}$  or 91% for other foods,  $e^{-.24}$  or 79% for apparel,  $e^{-.20}$  or 82% for household operation and  $e^{-.18}$  or 84% for miscellaneous, each of these representing consumption per head in the March quarter as a proportion or percentage of consumption per head in the December quarter, if all prices and income per head remain unchanged. Similar corrective factors can be calculated for  $S_2$  (June quarter) and  $S_3$  (September quarter), also as proportions of consumption per head in the December quarter.

The figures in brackets below the entries in the table are called the estimated standard errors of the particular figure to which they refer. They arise as a consequence of the fact that we do not know the elasticities and seasonal effects but have had to estimate them by statistical methods. These standard errors provide an estimate of the magnitude of error due to the use of the statistical procedures and their use is as follows. Although we do not know the true elasticities and seasonal effects we can be fairly sure (in the sense that if we make 100 statements, we can expect about 95 of these to

be correct and only about 5 to be wrong) that the true elasticity or seasonal effect lies within about two standard errors of the statistical estimate. In the case of the meat price elasticity of meat consumption for example, the elasticity estimate is  $-.72$  and the standard error is  $.08$ . We can therefore be about 95% sure that the true elasticity lies within  $2 \times .08$  or  $.16$  of  $.72$ , that is, between  $.56$  and  $.88$ . If we then make statements such as "If the price of meat increases by one per cent, then consumption per head of meat will fall by somewhere between  $.56\%$  and  $.88\%$ ", then we can be sure of being correct 95% of the time. Thus in the 45 elasticities and seasonal effects with standard errors that are in the table, we can expect that only about two or three of the true values are more than two standard errors away from the given estimates.

The only further figures in the table that require explanation are in the column headed  $R^2$ . These provide an indication of how well our theory and results have explained consumption per head of each commodity. The possibility of inexactness of human behaviour has been mentioned earlier and there exist other reasons such as inaccuracy of the data used or incompleteness of the theory behind the equations to indicate why we are not able to exactly explain all fluctuations in consumption of the commodities considered. The  $R^2$  figures indicate that we have successfully explained 91% of the variation in meat consumption per head, 94% of other food, 95% of apparel, 90% of household operation and 91% of miscellaneous by our theory of consumption per head depending on prices, income per head and seasonal effects. The remaining 9% for meat, 6% for other food etc., consist of

nonsystematic or random fluctuations that we have not been able to explain.

Some readers may point out that there exist other influences on retail consumption besides the ones considered here. Advertising for instance. Advertising may cause switches in consumption between items included in the individual groups, but is likely to have very little effect in switching consumption between groups as broad as the ones considered here. Other influences are included in the unexplained portion of each equation. This unexplained part causes little difficulty in using and interpreting the results and past experience has shown that attempts to reduce it are generally impracticable and not worth the effort involved.

Finally we give, in Figures 1 to 5, a visual impression of the extent to which the observed changes in consumption of the five commodity groups have been explained by our demand equations. In each figure the dotted line represents the level of consumption as calculated from the relevant equation, and this is plotted alongside the solid line representing the actual level of consumption. The discrepancies, in each case, between actual and calculated consumption, or, more accurately, the degree of concordance, give a visual impression of the size of the statistic  $R^2$  mentioned above.

FIGURE 1 QUARTERLY RETAIL SALES - MEAT

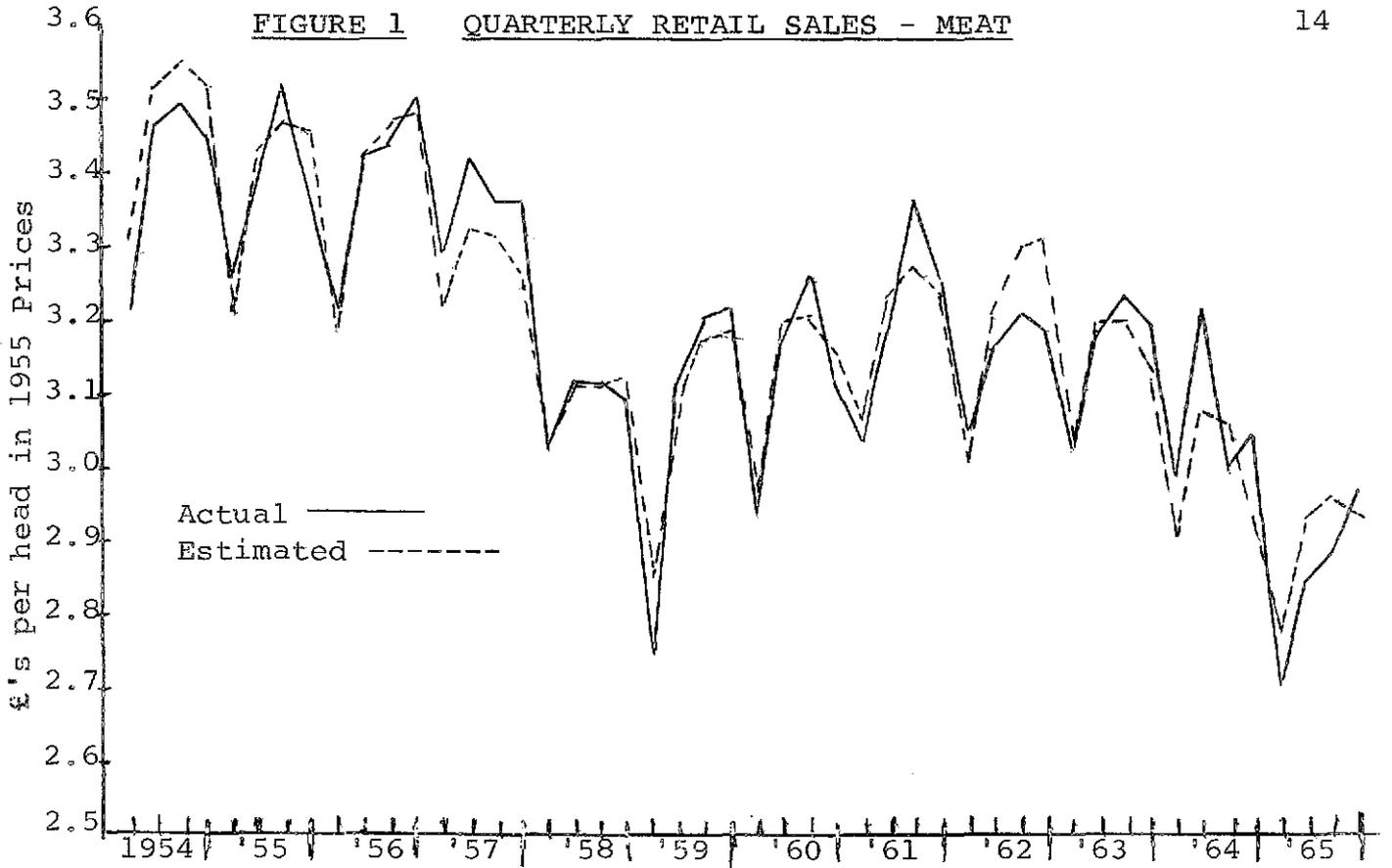


FIGURE 2 QUARTERLY RETAIL SALES - OTHER FOODS

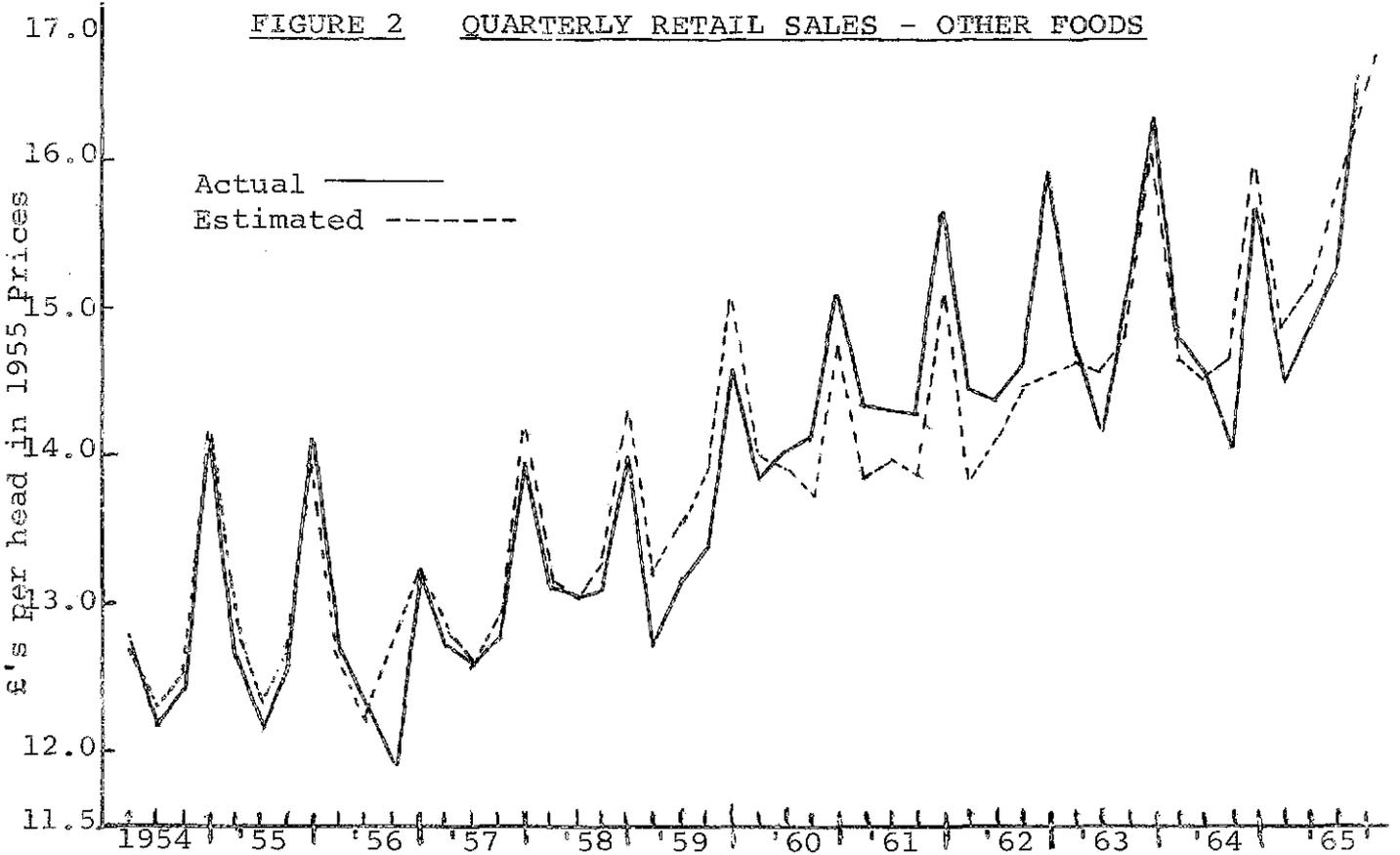


FIGURE 3 QUARTERLY RETAIL SALES - APPAREL

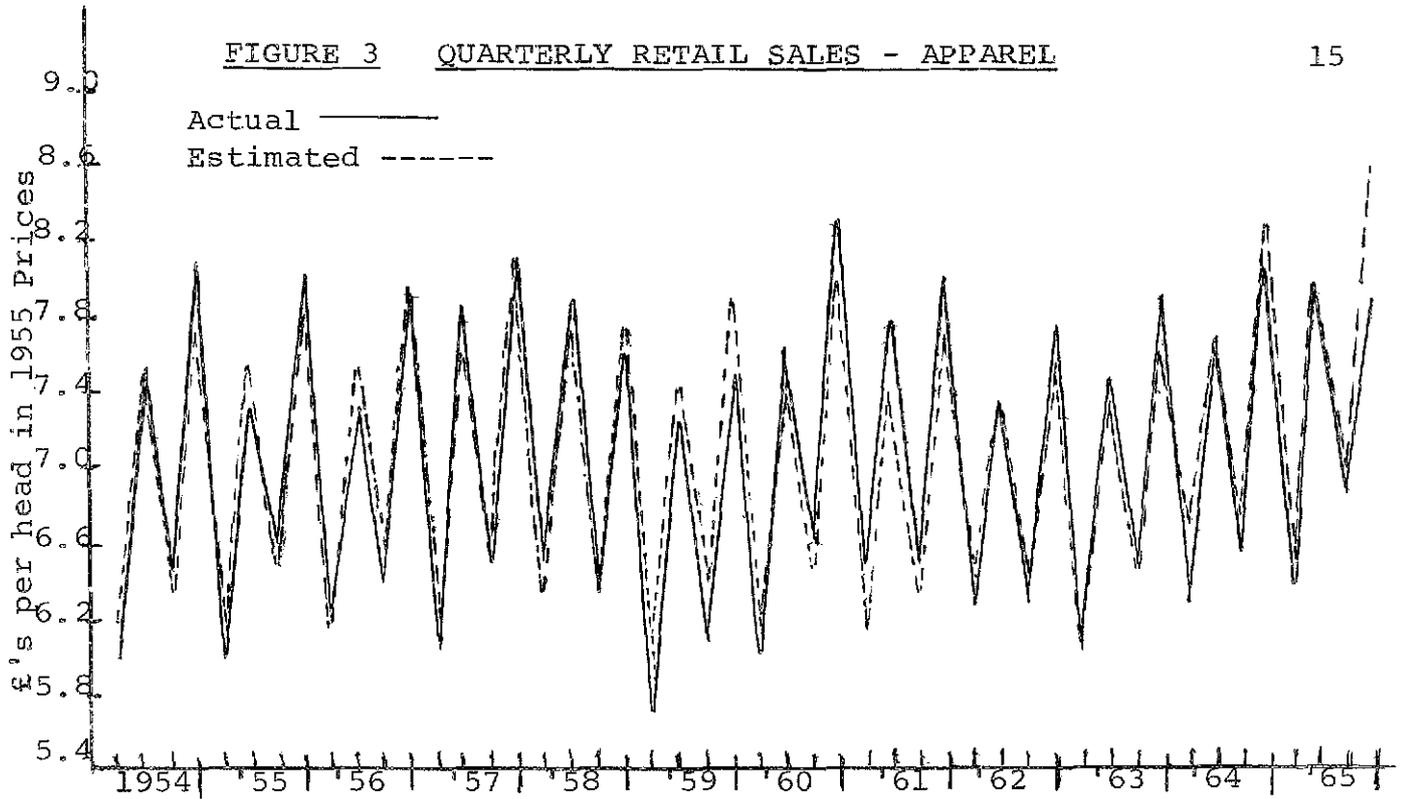


FIGURE 4 QUARTERLY RETAIL SALES - HOUSEHOLD OPERATION

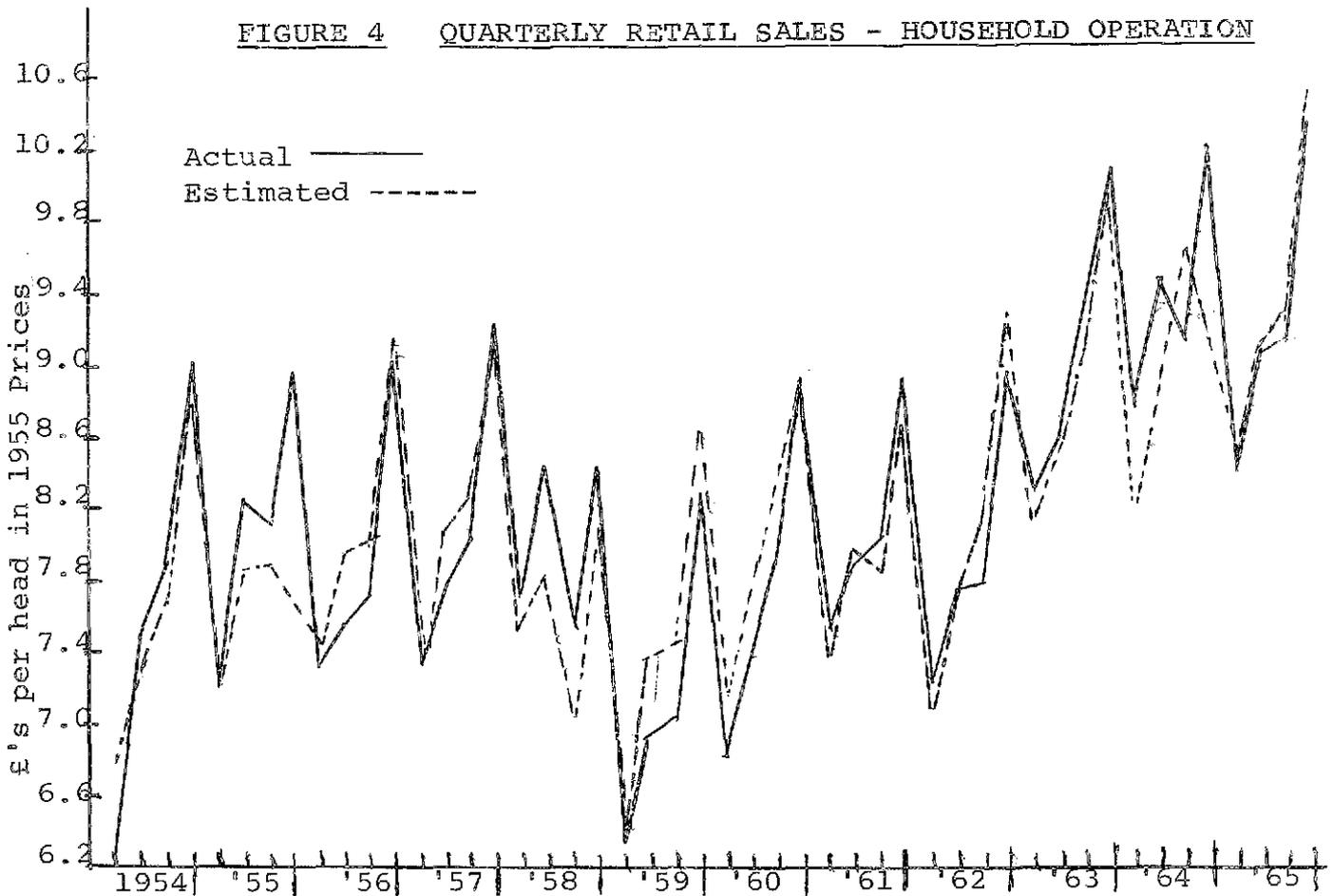
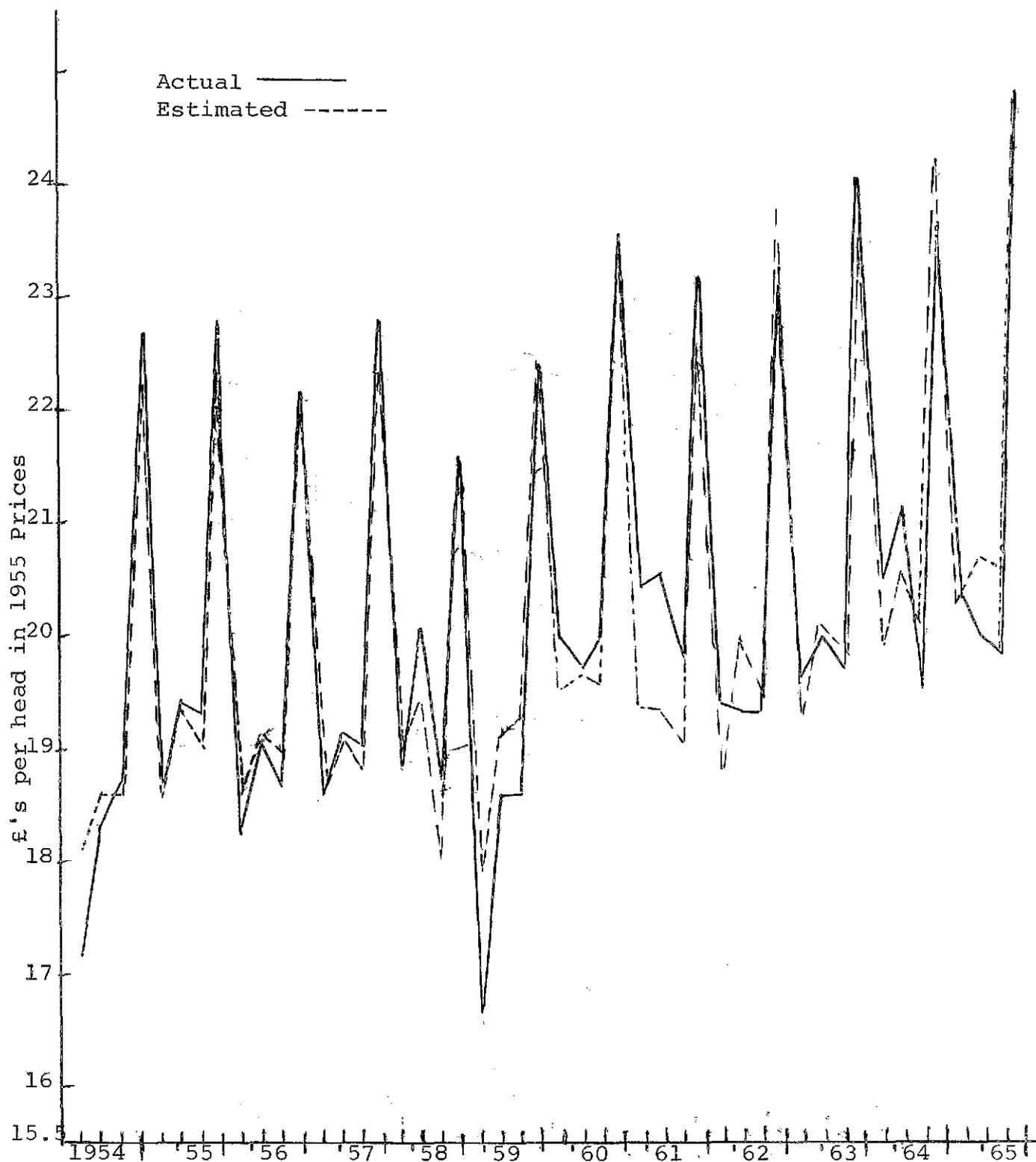


FIGURE 5    QUARTERLY RETAIL SALES - MISCELLANEOUS

## 5. PROJECTIONS OF RETAIL CONSUMPTION GROUPS

So far we have explained consumption per head of the five retail commodity groups considered by expressing consumption per head in terms of prices, income per head and seasonal effects, and estimating the constant elements of these assumed relationships. This enables us to project (in the sense of section 2) consumption in any season by substituting any assumed levels of prices, income, population and appropriate seasonal effect into the estimated equations.

The intention of this paper is to look ahead to 1970 and 1975, and although we do not know what prices, income and population will be in these years we are able to assume or choose some plausible levels and obtain projections consistent with the assumption that the chosen levels will be attained.

The details of obtaining the assumed levels of these explanatory variables are given in the appendix. Roughly, prices and income are assumed to keep on changing much as they have in the recent past, prices increasing by about 2.5% per year and real income increasing by about 5% per year (rather optimistically). The Government Statistician's population projections are accepted for population figures in 1970 and 1975.

A point of some importance, depending on the possible uses of the results, is the form the projections should take. That is, whether they should be in volume terms (i.e. at constant prices, 1955 = 1000) or in value terms (at price levels prevailing in the projection year). Generally, the projections of this paper are given in both value and volume terms.

Substituting the assumed prices etc., (suitably transformed) into the estimated demand equations provides projections for 1970 and 1975 in natural logarithms (base e) of volume of consumption per head for each commodity group as in the following table.

	<u>Meat</u>	<u>Oth. food</u>	<u>Apparel</u>	<u>House op.</u>	<u>Miscell.</u>
1970	1.0360 (.0286)	2.9276 (.0300)	2.2044 (.0374)	2.5920 (.0548)	3.3673 (.0414)
1975	.9741 (.0336)	3.0002 (.0350)	2.2594 (.0437)	2.7366 (.0640)	3.4340 (.0483)

These figures refer to December quarters in the stated years.

The bracketed figures are again standard errors and express the degree of confidence that we can feel in these results. The fact that we cannot be completely certain of these projections stems from two sources, firstly that we did not know the constants in the demand equations and had to estimate them and secondly, that there is a random element inherent in consumption that we could not explain by the theory used. Both of these points were briefly considered in the previous section.

The use of these standard errors of projection is slightly different from the standard errors of the previous section because in the previous case we were considering  $x$  constants whose numerical values could in principle be known exactly. In the current case we are considering variables with an inherent random element which can not be exactly determined, not even in principle. This fact expresses itself in a slightly greater degree of uncertainty concerning the results and only allows us to make statements

such as "at least 90% of future consumption levels (under the price, income and population assumptions made) have a probability of 0.9 of falling within 1.96 standard errors of the projected levels".

Obtaining upper and lower confidence limits of this type for each of the given projections provides the following table.

	<u>Meat</u>	<u>Oth. food</u>	<u>Apparel</u>	<u>House op.</u>	<u>Miscell.</u>
1970 Point proj.	1.0360	2.9276	2.2044	2.5920	3.3673
Lower limit	.9800	2.8688	2.1311	2.4846	3.2862
Upper limit	1.0920	2.9864	2.2777	2.6994	3.4484
1975 Point proj.	.9741	3.0002	2.2594	2.7366	3.4340
Lower limit	.9083	2.9316	2.1738	2.6112	3.3394
Upper limit	1.0399	3.0688	2.3450	2.8620	3.5286

But figures such as these in terms of natural logarithms of volume of consumption per head are not very useful for practical purposes. The most suitable form for the final projections depends of course on what these are to be used for. In the present paper it is considered adequate to give the final projection results in terms of total New Zealand expenditure on each commodity group, in both volume figures and value figures.

Thus transforming the above figures by taking anti-logs and multiplying the results by assumed population in the relevant years gives volume of consumption in £ million (at constant 1955 prices) as in the next table. It must be remembered that the figures refer only to the December quarters in each year. The corresponding figures that actually occurred for the December quarter in 1965 are given for comparison purposes.

Projections of volume of consumption (£ million in 1955 prices)

	<u>Meat</u>	<u>Oth.food</u>	<u>Apparel</u>	<u>House op.</u>	<u>Miscell.</u>
1970 Point	8.4	55.5	27.0	39.7	86.2
Lower	7.9	52.4	25.0	35.7	79.5
Upper	8.9	58.9	29.0	44.2	93.5
1975 Point	8.8	66.7	31.8	51.2	102.9
Lower	8.2	62.3	29.2	45.2	93.6
Upper	9.4	71.4	34.6	58.1	113.2
1965 Actual	7.9	44.3	22.1	27.6	66.1

Value of consumption projections are given in the next table. They are obtained by multiplying the volume projections by the relevant prices that it is assumed will prevail in 1970 and 1975.

Projections of value of consumption (£ million in 1970 and 1975 prices respectively).

	<u>Meat</u>	<u>Oth.food</u>	<u>Apparel</u>	<u>House op.</u>	<u>Miscell.</u>
1970 Point	14.5	69.4	33.5	51.0	128.4
Lower	13.6	65.5	31.1	45.8	118.5
Upper	15.3	73.6	36.0	56.8	139.3
1975 Point	17.9	89.8	42.3	70.7	172.6
Lower	16.7	83.9	38.8	62.4	157.0
Upper	19.1	96.2	46.0	80.2	189.8
1965 Actual	11.8	51.4	25.7	33.5	87.6

Probably projections of consumption for the entire years 1970 and 1975 are of more interest than projections for December quarters only. If we assume that average prices, income and population are the same in each other quarter as in the December quarters, then the only corrections required for the other quarters are seasonal corrections.

Applying the estimated seasonal corrections to the above volume projections for December quarters then provides projections for each quarter in 1970 and 1975,

and adding the quarterly figures together gives yearly totals, as indicated in the next table. No confidence limits are given, but actual 1965 figures are again given for comparison. Volume projections (£ million in 1955 prices)

1970 Qtr.ended	<u>Meat</u>	<u>Oth.food</u>	<u>Apparel</u>	<u>House op.</u>	<u>Miscell.</u>
(Proj.) March	7.7	50.6	21.2	32.5	72.1
June	8.1	50.4	25.9	34.9	74.3
Sept.	8.3	51.1	22.2	35.3	72.6
Dec.	8.4	55.5	27.0	39.7	86.2
Total	32.5	207.6	96.3	142.4	305.2

1975 Qtr.ended

(Proj.) March	8.1	60.8	25.0	42.0	86.0
June	8.5	60.5	30.6	45.0	88.7
Sept.	8.7	61.4	26.2	45.5	86.7
Dec.	8.8	66.7	31.8	51.2	102.9
Total	34.1	249.4	113.6	183.7	364.3

1965 Qtr.ended

(Actual) March	7.1	38.2	16.9	22.1	53.7
June	7.5	39.2	20.7	24.0	52.7
Sept.	7.6	40.3	18.1	24.2	52.5
Dec.	7.9	44.3	22.1	27.6	66.1
Total	30.1	162.0	77.8	97.9	225.0

Converting the year totals to value figures by multiplying by the appropriate prices gives projected retail consumption expenditure in 1970 and 1975 prices respectively as Value projections, totals for year (in £ million 1970 and 1975 prices)

	<u>Meat</u>	<u>Oth.food</u>	<u>Apparel</u>	<u>House op.</u>	<u>Miscell.</u>
1970 (proj.)	56.0	259.5	119.6	182.8	454.7
1975 (proj.)	69.4	335.9	151.0	253.7	610.9
1965 (actual)	43.7	186.9	89.9	117.9	296.1

Thus, under the stated assumptions about prices, income and population, we expect that during 1970 New Zealanders

will spend about £56 million on meat, £260 million on other foods, £120 million on clothing and footwear, £183 million on household operation and £455 million on the items included in "miscellaneous", or about £1073 million in total. Similarly we expect that a total of £1421 million will be spent on retail items in 1975.

It should be remembered that the projections discussed in this and subsequent sections refer to the Statistics Department's sample figures and not to total retail sales in New Zealand. The projections therefore provide a measure of the percentage change in the sales of each commodity group sample rather than a measure of their absolute levels in 1970.

## 6. AGGREGATED RETAIL CONSUMPTION - EXPLANATION AND PROJECTION

It is of interest, as well as being useful and providing a check on the preceding results, to project total retail trading figures (not broken down into groups) to 1970 and 1975, using the same general method as previously.

The total value of retail consumption (in the Government Statistician's sample) is the total of the five groups previously considered. The overall retail price used is a fixed weight index of the five individual group prices, whence the volume of consumption (in 1955 prices) is obtained by dividing the value figure by the price index. Income, population and seasons are the same as before.

An equation is set up on the same lines as the previous equations which explains volume of consumption in terms of price, real income per head and seasonal dummy variables. All variables except seasonal are in natural logarithms so the constants of the equation have the same meanings as before, being either elasticities or proportional seasonal effects.

Statistical estimation of this single equation using the method of least squares provides the following values for the constants, the standard errors and the  $R^2$ .

$$Q = -.384P + .475M - .161S_1 - .110S_2 - .133S_3 + 1.9294$$

(.044)	(.053)	(.009)	(.009)	(.009)	$R^2 = .926$
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We can see that about 93% of the variation in total retail consumption is explained by this equation, and that the standard errors are satisfactorily small, indicating that we have been able to isolate the influence of each variable with a fair degree of precision.

Substituting assumed prices and income per head in the equation provides point projections for the logarithm of volume of total retail consumption per head in the December quarters, 1970 and 1975 as

	Proj.
1970	4.2805 (.0310)
1975	4.3504 (.0360)

Standard errors of projection have been calculated and are the bracketed figures above. Converting these to obtain confidence limits (in this case at least 90% of future consumption levels have, under the assumption about prices, income and population, a .9 probability of falling within 1.96 standard errors of the point projections) we then have

	Proj.	Lower	Upper
Dec. Qtr.1970	4.2805	4.2201	4.3409
Dec. Qtr.1975	4.3504	4.2802	4.4206

Transforming these figures to obtain volume of consumption in £ million, 1955 prices, and value of consumption in £ million, 1970 and 1975 prices provide the next table.

<u>Volume</u>	Proj.	Lower	Upper
Dec.Qtr.1970	214.9	202.3	228.2
Dec.Qtr.1975	257.3	239.9	276.1
<u>Value</u>			
Dec.Qtr.1970	294.6	277.4	312.9
Dec.Qtr.1975	389.8	363.4	418.3

The projections of total value of retail expenditure in the December quarters 1970 and 1975 can be compared with

the sum of projected values of expenditure for each of the five commodity groups as obtained in the previous section.

	1970	1975
Projection of total expenditure	294.6	389.8
Sum of individual expenditures	296.8	393.3

The sum of individual expenditure projections is in each case close to the projected total, and certainly well within the indicated confidence limits. This shows at least that the method used gives reasonably self-consistent results.

As stated previously it is of more use to obtain projections for a whole year than for just the December quarter. Therefore, projections of total retail consumption are calculated for each quarter in 1970 and 1975 under the assumption that price, income and population assumed for the December quarter also prevail throughout the whole year. The only corrections required for the other quarters are therefore seasonal multiplicative effects.

Volume of total retail consumption (£ million, 1955 prices)		
Qtr.ended	1970	1975
March	182.7	218.8
June	192.5	230.5
Sept.	188.1	225.2
Dec.	214.9	257.3
Total	778.2	931.8

Value of total retail consumption (£ million, 1970 and  
1975 prices)

Qtr.ended	1970	1975
March	250.5	331.5
June	263.9	349.2
Sept.	257.9	341.2
Dec.	294.6	389.8
Total	1066.9	1411.7

The results are thus obtained that, if the price, income and population levels that we have assumed for 1970 and 1975 are fulfilled, then total expenditure on retail items in New Zealand (according to the Government Statistician's sample) will be about £1,067 million in 1970 and about £1,412 million in 1975.

We can compare these results with the summed projections for the individual commodity groups of £1,073 million and £1,421 million, and note that the correspondence is quite satisfactory for any practical purposes.

## 7. SHORTER-TERM FORECASTING

There is a considerable advantage in specifying one's results as "projections" in the sense that it is very difficult to prove such projections wrong. For if the projected results do not come about, it is generally possible to say that this is because the assumptions upon which the projections depend have not been fulfilled. Also, if the projections refer to events some years in the future, it is easy to lose interest in the results with the passage of time, especially if wars or similar upheavals intervene or if the rate of advance of knowledge renders the projection methods obsolete.

But any such method which purports to give accurate results for many years in the future should also project accurately for shorter periods, say up to one year in the future. It is over such shorter periods that the projection procedures of this paper are now put to work, partly to test these procedures against reality and partly to provide results of more immediate use than those given so far.

It will be remembered that the basic procedure of this paper is to explain consumption per head in terms of relative prices, real income per head and the seasonal effects. In the short-run we can expect relative prices to change very little, real income per head will not change much either and will do so in a fairly predictable way. The dominant effects on consumption in the short-run will be seasonal and the occurrence of seasons is something that is exactly known; thus apart from the minor effects of prices and income, we can obtain forecasts (as distinct from projections) of New Zealand retail consumption.

In the long-run of course it is real income and population that are the dominant influences on retail consumption and most of the results of this paper (apart from those in this section) depend heavily upon the assumptions made about these variables.

The data used in estimating the constants of the equations in this paper were, as mentioned previously, quarterly figures published by the N.Z. Statistics Department and the latest available figures for estimation referred to the quarter ended December 31, 1965. The forecasts of this section are given for each quarter of 1966 and for the whole of 1966. Although part of 1966 has passed at the time of writing, the figures given are still forecasts in the sense that they only use information that was available not later than December 1965. Figures published subsequently to December 1965 are used only as a check on the results, effectively using hindsight to see how accurate the forecasts in fact were, and presuming that they will be similarly accurate for the future although this presumption can not yet be verified.

On the basis of recent past experience, plausible assumptions for 1966 are that all prices and population will rise by 0.5% per quarter and that disposable income will rise by 1.8% per quarter, whence real disposable income per head rises by 0.8% per quarter.

Using the December quarter, 1965 levels of

price of retail commodities	= 1,248
price of all other consumer goods	= 1,490
population	= 2.667 million
disposable income	= £367 million

(where the prices are in terms of the base 1955 = 1000),

as a base for these assumed percentage increases, the aggregate retail demand for each quarter in 1966 is forecast from the aggregated retail equation of section 6 as

Qtr.ended	March	June	Sept.	Dec.
Forecast	3.9913 (.0248)	4.0451 (.0248)	4.0259 (.0250)	4.1631 (.0249)

These forecasts are in natural logarithms of volume of consumption per head, and standard errors of forecast are in brackets.

Converting the forecasts to volumes of consumption in £ million at constant 1955 prices and the standard errors to confidence limits (such that at least 90% of the actual levels being forecast have .9 probability of falling within these limits) gives us

1966	Forecast	Lower	Upper
March qtr.	£145.1 million	138.2	152.2
June "	£153.9 "	146.6	161.5
Sept. "	£151.7 "	144.5	159.3
Dec. "	£174.9 "	166.6	183.6

Converting these figures to forecast value of consumption (i.e. total retail sales) by multiplying by the assumed price prevailing in each quarter gives us

1966	Forecast	Lower	Upper
March qtr.	£182.0 million	173.3	190.9
June "	£193.9 "	184.7	203.5
Sept. "	£192.1 "	182.9	201.7
Dec. "	£222.5 "	211.9	233.5
Total for year	£790.5 million		

We have obtained the £182.0 million value figure for the March quarter by multiplying the volume figure of £145.1 million by  $1248 \times 1.005 = 1254$ , i.e. the average retail price assumed to prevail in the March quarter, 1966. The £194.1 million value figure for the June quarter results from multiplying the £153.9 million volume figure by  $1254 \times 1.005 = 1260$  etc.

The total value of retail sales forecast for 1966 of £790.5 million, compares with the actual total sales of £650.2 million in 1963, £694.9 million in 1964 and £734.5 million in 1965 as recorded by the Government Statistician.

During the preparation of this paper, official retail trading figures for the quarter ended March 1966, came to hand. The observed total value of retail sales is £181.041 million, which is well within the confidence limits of £173.3 - £190.9 million and is very close to the point forecast of £182.0 million. The percentage error is + .53%, which is very small indeed when compared with the results of most economic forecasting.

Going over to the five individual commodity groups we can make the same assumptions about increase in prices, income and population to obtain forecasts for the March quarter, 1966, from the five explanatory equations. These forecasts are compared with actual values in the following table and percentage errors given. All figures except the percentages are in £ million at prices prevailing in the March quarter, 1966.

## March qtr.1966

Commodity	Meat	Oth.food	Apparel	House op.	Miscell.
Forecast	10.8	47.7	20.7	28.2	74.2
Observed	10.9	46.6	20.0	27.9	75.7
% error	- .9%	+2.4%	+3.5%	+1.1%	-2.0%
March 1965 (observed)	10.0	44.2	19.4	26.4	69.8

The observed figures for the quarter ended March 1965 are given for purposes of comparison. It is very obvious that the forecasting method of this paper gives much more accurate results than the simpler and naive method of assuming no change from year to year in value of sales.

Forecasts for individual commodity groups are not given for the last three quarters in 1966, but these may easily be calculated from the given equations, as may similar forecasts for any quarter in 1967 or any desired year.

## 8. SOME COMMENTS ON THE RESULTS

Quantitative information regarding the behaviour of the New Zealand purchasing public should be of value to those concerned with the retail trade as well as to those involved with government policy in New Zealand. A few uses to which these results might be put are suggested below, and anyone interested in more detailed applications could easily add to these suggestions.

Exports of meat are, as is well known, a very important component of New Zealand's external trade and, considering

the chronic balance of payments difficulties, it would seem desirable to export as much meat as possible. Evidently the more meat that is consumed in New Zealand the less will be left over for export, so a possible policy measure may be to reduce the domestic consumption of meat. This measure would not hurt the typical New Zealander much in a physical sense, as his average meat consumption per head is currently the highest in the world. (Some comparative figures for the early 1960's are, New Zealand 256 lbs of meat per head per year, Australia 240 lbs, United States 212 lbs, France 163 lbs, Japan 15 lbs etc. Figures from 1965 N.Z. Yearbook, p.734.)

Any attempt to decrease New Zealand meat consumption per capita through a policy relating to income (by increasing income tax for instance) would have negligible effect because of the very low income elasticity for meat (estimated at .03). Also such an attempt could have undesirable effects on the consumption of other commodities and could also have serious political repercussions.

However, a one per cent sales tax on meat would reduce consumption per head by about .7% and would have a negligible effect upon consumption of other commodities (excepting perhaps apparel). A two per cent sales tax on meat would have a 1.4% depressing effect on meat consumption, or the tax rate would be manipulated (within reason) to produce any desired percentage reduction. A one per cent subsidy on meat could similarly increase meat consumption per head by about .7%.

Evidently, sales tax or subsidy policy could be selectively used to promote or reduce consumption of any commodity group by any desired amount.

As another use of the results we can note that, as income per head rises, the consumption of "miscellaneous" commodities rises much faster than does meat consumption, because of the higher income elasticity. This would suggest that projected investment in new retail establishments should be much more in the direction of "miscellaneous" establishments (that is, chemist, general department and variety etc.) than in the direction of new butchers' shops. Generally, investment in retail establishments should tend to be more concentrated towards those groups having the higher income elasticities as these have the greater prospects for growth as New Zealand develops.

If it is the desire of retailers to increase their total receipts then, provided they all act together, they should increase the price of meat, other food and apparel, for, as the price elasticity of each of these groups is between zero and minus one, an increase in price will result in a less than proportional decrease in volume of sales, giving an increase in value of sales. The converse is true for household operation and miscellaneous groups since these have price elasticities less than minus one. A rise in price would therefore decrease receipts, a reduction in price will increase receipts. Of course, unless there is concerted action, competition among retailers will tend to prevent planned price changes of this nature. A retailer raising prices on his own will lose customers to other shops selling similar commodities.

Short-term forecasts of the volume of retail sales should be of use to retail traders in assisting them with ordering and stocking or inventory policy. In this

connection the isolation of seasonal effects upon retail demand is important as this indicates for instance how much a retailer should order to cope with Christmas shopping as compared with say shopping over the winter months. Probably the results of this paper are somewhat too general to be of great use in this direction. It is quite possible that general seasonal effects on consumption are different in Auckland to what they are in Christchurch, but this is something that could only be shown by a more detailed analysis than the one undertaken here.

We can conclude with some general comments on this paper. As has been noted the influence of prices is not very great, as changes in relative prices are likely to be much less than the seasonal effects in the short-term and changes in real income in the long-term. The use of the standard errors, indicating reliability of results, is something of an innovation for projection work of this nature. These standard errors and their use are soundly based in statistical and economic theory and allow any user of the results to judge whether these are sufficiently precise for his purposes. All projection work is subject to error of some kind (nobody knows the future) but a knowledge of the magnitude of expected error in results may be just as important as the results themselves.

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Sources of Information

In choosing the degree of breakdown of commodity groups for projection purposes, points to consider are the purpose for which projections are required, the data available and the computational cost of producing the projections.

The data for the present study are derived from figures published by the New Zealand Statistics Department. Quarterly value figures of sales from a sample of retail establishments are given for items classified by both store-type and commodity-type. The commodity classification is conceptually the more satisfactory for projection purposes, but published series begin in 1959, whereas the store-type classification is published from the March quarter, 1954, onwards. The latest figures available at the time of writing refer to the December quarter, 1965, thus the store-type sales figures provide 48 quarterly observations for estimation purposes.

Price data are obtained from published components of the New Zealand consumers' price index. There is not much of a tie-up between these prices and the retail sales figures, hence some reconciliation is needed before proceeding. Five groups is the maximum number that can be handled with the available computational facilities, hence five groups are sorted out for which projections are of interest and for which price and sales data show a reasonable correspondence.

The groups chosen are

1. Meat
2. Other food
3. Apparel
4. Household operation
5. Miscellaneous

and together these include the value of all retail sales. These groups are related to the published value of sales and price data as follows:

Value of store-type sales.

- |                         |  |
|-------------------------|--|
| 1. Meat:                | sales of "butcher, poulterer etc." type stores.          |
| 2. Other food:          | "grocer" and "other food and drink"                      |
| 3. Apparel:             | "footwear" and "other apparel"                           |
| 4. Household operation: | "furniture and soft furnishings", household appliances   |
| 5. Miscellaneous:       | "chemist", "general department and variety" and "other". |

Prices

- |                         |  |
|-------------------------|--|
| 1. Meat:                | "meat and fish" component of consumers' index.   |
| 2. Other food:          | "fruits, vegetables and eggs" aggregated with "other foods" using weights 0.33 and 0.67 respectively.        |
| 3. Apparel:             | "apparel" component of consumers' index.   |
| 4. Household operation: | "home furnishing" aggregated with "domestic supplies and services" using weights 0.64 and 0.36 respectively. |
| 5. Miscellaneous:       | "other supplies" component.  |

The aggregation weights are proportional to the official weighting of these components in the overall index.

Volume of retail sales in each group (in constant prices. base 1955=1000) is obtained by dividing each value series by the appropriate price series.

Other variables used in the demand equations besides the above prices and volumes (or "quantities") are income, population and a price index of all goods in the consumers' budget not included above.

(iii)

The income figure used is private disposable income, for which annual figures are published in New Zealand Official Yearbooks. These annual figures were interpolated to obtain estimates of quarterly income.

Estimated population figures at the end of each quarter for New Zealand are published in the New Zealand Statistics Department Annual Reports on Migration, Population and Building, and are averaged to give average quarterly population.

The price index of all other goods, or "other prices" consists of all components of the consumers' index, other than those of the five groups above, aggregated according to the official weights.

In addition to projecting individual retail groups, total retail trading figures are also projected. The value of all retail sales in the sample is given by the sum of the above five groups, price is obtained by aggregating the five individual prices using official weights, and volume of sales comes from dividing total value by price. The income, population and "other price" variables are the same as before.

The aim of the study is to project retail trading figures to 1970 and 1975 under specified assumptions about levels of prices, income and population prevailing in these years. Government has given no indication of possible targets for these years regarding price, income or migration policy, so the best we can do is assume that things will continue on much as they have in the past and produce a set of illustrative projections that can be modified wherever necessary.

Between now and 1975 therefore, prices are assumed to rise by about 2.5% per annum, and real disposable income by about 5% per annum (rather optimistically, judging by past experience) whence disposable income in current prices will rise by about 7.5% per annum. The Government Statistician's population projections, assuming 15,000 per year net immigration and that average 1965 specific age-of-mother and marital status birth-rates will continue, are accepted.

(iv)

Numerically, estimated disposable income for the December quarter, 1965, is £416 million, whence 7.5% annual growth will result in £597 million and £857 million for the December quarters, 1970 and 1975 respectively. Individual prices for the December quarters 1970 and 1975, obtained by extrapolating from linear trends fitted for the years 1960 to 1965 are, together with assumed income and population, as follows:-

	December quarter	
	<u>1970</u>	<u>1975</u>
Price meat	1724	2035
Price other food	1250	1347
Price apparel	1242	1329
Price household operation	1284	1381
Price miscellaneous	1490	1677
Price "other items"	1680	1896
Disposable income	£597 mill.	£857 mill.
Population	2.973 mill.	3.320 mill.

All prices are indexes with base 1955=1000.

It is emphasized that the above figures are assumptions, not predictions.

To project aggregated retail demand, the first five prices above are aggregated as before, using official weights, to obtain assumed price indexes for total retail sales in the December quarters, 1970 and 1975, as 1371 and 1515 respectively. The price of "other items", disposable income and population are as above.

## PUBLICATIONS

1964

1. *The Systematic Evaluation of Development Projects*, J. T. Ward
2. *The New Agricultural Economics Research Unit*, B. P. Philpott
3. *Indicative Planning for the Poultry Industry in New Zealand*, J. T. Ward
4. *The International Sugar Situation and New Zealand's Sugar Policy*, A. R. Frampton
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1966

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33. *The Economics of Hill Country Development*, J. S. Holden (Reprint)
34. *Report on a Survey of Farm Labour in Patangata County, Hawkes Bay 1965-6*, D. McClatchy
35. *Programming Farm Development*, G. A. G. Frengley, R. H. B. Tonkin and R. W. M. Johnson
36. *Productivity, Planning and the Price Mechanism in the New Zealand Manufacturing Industry*, B. P. Philpott
37. *Some Projections of Retail Consumption in New Zealand*, R. H. Court

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