THE DEMAND FOR MEAT IN ENGLAND AND WALES, 1920-1938

Forrest Capie

NUMBER 40

WARWICK ECONOMIC RESEARCH PAPERS

DEPARTMENT OF ECONOMICS

UNIVERSITY OF WARWICK
COVENTRY

THE DEMAND FOR MEAT IN ENGLAND AND WALES, 1920-1938

Forrest Capie

NUMBER 40

January 1974

Attention has often been given to the supply of livestock products to the British market in the first half of the twentieth century, note being made of the influence of prices, incomes, wars, the Ottawa agreements and other economic and institutional factors.(1) On the other hand very little has been said by the economic historian about demand, particularly in the inter-war years when an examination of demand is of interest for two good reasons.(2) Firstly there is the obvious one of shedding some light on living standards in the period and associated with this is the interest that lies in identifying the factors important in determining demand. There is also the possibility in demand analysis of showing the extent of price and income responsiveness and the degree of substitutability between varieties of the product and further to suggest in the light of that information what policies might have proved most effective in, for example, the raising of prices or the promotion of the home produced variety at the expense of the imported one.

This paper proceeds then, after briefly discussing the data and the statistical method used, to estimate the demand for various meat products, and to compare the results obtained with other empirical work done. The conclusions of our analysis are that in general price elasticities for imported meats were higher than those for home produced meats, a result which lends support to the

---

(1) See for example: Ministry of Agriculture and Fisheries, Agricultural Output and Food Supplies of Great Britain, 1929; R.A. Mackness, 'Beef Supplies in the United Kingdom', Journal of Agricultural Economics, June 1956; R. Duncan, 'The Australian Export Trade with the United Kingdom 1880-1940', Business Archives and History, August 1962; A.W. Flux, 'Our Food Supply Before and After the War', JRSS Vol. XCIII Pt IV 1930; R.J. Hammond, 'British Food Supplies', Econ. Hist. Rev. Vol. XVI No. 1 1946; R.H. Hooker, 'The Meat Supply of the United Kingdom', JRSS 1909; Richard Perren, 'The North American Beef and Cattle Trade with Great Britain, 1870-1914', Econ. Hist. Rev. Vol. XXIV No. 3, 1971.

(2) Some work has been done by economists e.g. J.R.H. Shaul, 'The Demand Curve for Beef in Great Britain', Economic Journal, Vol. XLV September 1935; A.R. Bergstrom, 'Supply and Demand for New Zealand's Exports', Econometrica, Vol. 23, July 1955.

argument that imports were of lower quality than the domestic item, and further suggests that a price-raising policy would not have derived great benefit from a restriction of supply of such a product. The income elasticity was invariably negative, a rather curious result at first sight, but one which we suggest should not simply be dismissed as statistical error or poor data. An examination of the contemporary evidence[3] on meat consumption lends some support to the view that as income increased total meat consumption rose. But the quantity of individual meats declined and the varieties eaten increased and this latter feature may be the explanation for the negative sign of our income coefficient.

I

There are two main sources for the quantities of meats: a) The Trade and Navigation Accounts for the imported product[4] and b) the Ministry of Agriculture for the domestic product.[5]

Imports were divided into various classifications in the Accounts. For instance beef is given in various preservation groups: fresh, chilled, frozen, salted, others. And it is divided into hindquarters, forequarters, boneless, tongues, other (offal), tinned and so on. Other meats are broken

---

(3) See for example, J.B. Orr, Food Health and Income, (London 1937); Sir Wm. Crawford, The People's Food, (Heinemann, 1933); B. Seebohm Rowntree, Poverty and Progress, (Longmans, 1942), discussed later.

(4) Board of Trade, Annual Statements of Trade 1920-1940. Supplementary material in International Institute of Agriculture, Internation Trade in Meat (Rome, 1936) and BPP 1935 Vol. XVII, Cmd 4838. Import of Meat into the United Kingdom.

(5) Ministry of Agriculture and Fisheries, Agricultural Statistics, 1922, 1923-25, 1926-28, 1936, 1939, 1939/40-1945/46; Agricultural Output of England and Wales, (1925); Meat, A Review of Production Trade, Consumption and Prices, 1935-1944 (Annually); Marketing of Sheep, Mutton and Lamb, Economic Series No. 29 1931; Marketing of Cattle and Beef, Economic Series No. 20 1929; Trade in Refrigerated Meat, (1925).

down in a similar fashion. We collated the principal cuts in each preservation category and excluded all lesser types such as tongues, kidneys, etc. When therefore we refer to Argentine beef, we are discussing the principal variety of that product, namely chilled. Equally New Zealand lamb is made up of the main cuts of New Zealand frozen lamb and so on. This was done primarily because of prices available and also to come closer to the retail description of meats. Since imports were weighed at the port of entry quantities are in hundredweights as in the Annual Statement. Production statistics for the domestically produced item have been provided in various forms by the Ministry of Agriculture and Fisheries, and while not always in ideal form it was possible to build up an annual series for the period, of the major types of meat. We have then quantitites of British, Australian, Argentinian and New Zealand lamb, mutton and beef.(6) In other words in this analysis we were able to test twelve varieties of meat.

The Ministry of Agriculture also provided excellent series on prices. These are available in monthly form(7) as well as annual though it was the latter that were of use to us, for matching with the annual quantity data. In some instances no matching price and quantity figures were available and where this was the case an a priori close substitute's price was used as a surrogate. For example, an average price for British beef was not available but individual prices for English long sides, English short sides etc. were. The quantities available were for British beef as a whole. We therefore took each of the beef prices in turn as a proxy for the average.

The income series used was net national income at current prices

---

(6) This last item usually includes veal but since the quantitites of veal were very small and in any case comparable with beef it was not thought important to deduct them.

(7) The sources for prices are as for quantities. There are also very detailed records of weekly prices in major English markets in PRO MAF 15/53-58.

deflated by the cost-of-living index,[8] and population figures are as given in Stone.[9]

II

The aim of the demand analysis is to estimate parameters such as own-price elasticities using multiple regression analysis on time series data for 1920-1938. The demand for a perishable agricultural commodity is different from that of an industrial product, the direction of causation being reversed, current price being influenced by the clearing of the market. For this reason single regression equations were estimated in which price was expressed as a function of quantity coming on to the market.[10] No account was taken of stocks in view of the perishable nature of the product and the fact that even for the frozen variety of the product (i.e. the most easily kept), stocks were infinitessimal. Many studies have proceeded in this manner.[11] Fox says "if we assume that the disturbances of residuals from this relationship are random and normally distributed, this equation is identical with the maximum likelihood estimate ... In other words the single equation method ... is fully justified in this case".[12] That is to say we regard supply as exogenously determined. (Britain was the major world market and there were few opportunities for diverting supplies elsewhere).

---

(8) B. Mitchell and Phyllis Deane, Abstract of British Historical Statistics (Cambridge, 1970), p.368; Chapman and Knight, Wages and Salaries in the United Kingdom, (Cambridge, 1953), p.30.

(9) J.R.N. Stone, The Measurement of Consumer Expenditure and Behaviour in the United Kingdom 1920-1938, (Cambridge, 1954), p.414.

(10) In fact this producedure is not strictly necessary and very similar results are obtained when the demand function is put in its conventional form.

(11) See B.P. Philpott and Mary J. Matheson, An Analysis of the Retail Demand for Meat in the United Kingdom, (Lincoln College, NZ 1965); G.W. Taylor 'Meat Consumption in Australia', Economic Record, March 1963.

(12) K. Fox, Econometric Analysis for Public Policy, (Iowa, 1958), p.34.

The form of the equation for testing is:

$$Px_t = a_1 + b_1 qx_t + b_2 qz_t + b_3 Y_t$$

where Px_t = price of meat x in current period

qx_t = quantity of meat x in current period

qz_t = quantity of meat z in current period

Y_t = income in current period

Population change is taken account of by reducing the variables to a per capita basis and then when the variables have been expressed in logarithms the coefficients obtained in the solved regression equations represent relationships between proportionate changes in the variables.(13)

Our approach to demand is therefore to use a single equation in which it is argued the correct identifying variables are income, prices, prices of other goods and population change. Logging the variables provides the proportionate change in each and a simple transformation produces the desires elasticities. These parameters are useful for ranking the products according to quality and degree of substitutability. The procedure followed in each case was first to regress price on quantity for each product and then to introduce the quantities of other meat products into the equations and finally to observe the influence of income. In all cases the equations are in logarithmic form and the independent variables are per capita ones. The results presented here, together with some discussion, are simply a selection from the total.(14)

---

(13) From here it is only a short step to the derivation of the elasticity. Because of the reversed form of the equation the price elasticity is the reciprocal of the coefficient obtained on quantity and the income elasticity is obtained by using that coefficient and the price coefficient. The signs of the coefficients remain unchanged. See Appendix I.

(14) The method of deriving the elasticities together with a table of elasticities is presented in Appendix I.

Lamb: The simple regression of price on quantity was run. For British and New Zealand lamb the results were 'good' in the sense that they offered 78% and 86% respectively of the 'explanation' of the price movement. In the Australian case the explanation was less good - 60%, and in the Argentinian case the result was poorer with an R^2 statistic for the equation of .44.

In all four cases the coefficients were significant at the .01 level though clearly the British and New Zealand estimates are more valuable. It is however, with the introduction of other variables that the explanation is improved, e.g. the explanation for the movement in price of British lamb is raised slightly to 88% by the introduction into the equation of real income, and the R^2 is raised to 95% by the introduction of the quantity of New Zealand lamb. The coefficients are again significant at the .01 level.(15)

$$\begin{aligned} PBL &= 7.247 - .832\ QBL - .427\ QNZL \\ &\quad (.432) \quad (.154) \qquad (.058) \\ R^2 &= .9458 \\ DW &= 1.6907 \end{aligned} \qquad (1)$$

where PBL = Price of British lamb

QBL = Quantity of British lamb per head

QNZL = Quantity of New Zealand lamb per head

We are able to accept the null hypothesis that the errors were not autocorrelated at the 5% level. And the signs and magnitude of the elasticity estimates meet with theoretical expectations.(16)

---

(15) Throughout the presentation of the results in the text, the standard error of the estimate is, in accordance with convention, given in brackets beneath the estimate. The coefficient of determination is in all cases corrected for the number of variables.

(16) Autocorrelation biases the standard errors downwards thus leading to situations where we regard the coefficient as significant when in fact it is not.

The results for Australian frozen lamb show that the direct price elasticity estimates are much larger than those obtained for the British product suggesting that the Australian product was much more sensitive to price movement, that it had more substitutes than the British variety:

$$\begin{aligned} PAUL &= 3.521 - .295\ QUAL - .736\ Y \\ &\quad (.467) \quad (.124) \quad (.679) \\ R^2 &= .6009 \\ DW &= .5638 \end{aligned} \qquad (2)$$

where PAUL = Price of Australian lamb

QUAL = Quantity of Australian lamb per head

The degree of explanation is satisfactory but our confidence cannot be great in view of the probable serial correlation of residuals as indicated by the DW statistic. Nevertheless the elasticity estimates are of a magnitude that we would expect. The quantity coefficient is significant at 5% while, that for income is only significant at 10%.

Argentinian frozen lamb was comparable with Australian in that direct price elasticities were high.

New Zealand lamb has lower price elasticities, according to these results, than either Australian or Argentinian, falling between these two and the British. An interesting point is that the income elasticities are of approximately the same magnitude as the British lamb. One example where the coefficient of determination was very good, doubt over autocorrelation in the residuals was removed by the DW statistic, and where coefficient estimates were significant at the 1% level, gave elasticity estimates as follows:

Direct price elasticity NZL = -1.497

Income elasticity NZL = + .666

After the above analysis was carried out for the whole period 1920-1938, the period was split into two sub-periods 1920-30 and 1928-38, keeping, in both cases, a sample size of eleven observations - hence the overlap. This was done in order to see if there were any significant differences between the 1920s and the 1930s, or to see if there were some identifiable structural change in the period. The results obtained were always in doubt. The small sample reduced our confidence, though it must be said that the results were everywhere as good as those obtained for the period as a whole.

For British lamb the equations are similar for both sub-periods, and close direct price elasticity estimates were obtained. The income coefficient also seems to fall in line with the previous result. If there is one generalisation possible from the sub-period analysis it is that the coefficients were higher in the twenties than the thirties i.e. the derived elasticities were lower in the first period. In other words lamb became more price elastic in the thirties.

A further test and one which is in many ways more rigorous, confirms this tentative result.(17) The test is as follows. The years 1920-29, i.e. ten observations, are taken first and the regression equation run. The period was then extneded to 1930, the regression re-run, and so on. Thus ten coefficients are obtained. By extending the period by one year in the manner outlined it should be possible to detect which year if any makes a significant change in the coefficient, or alternatively simply to observe the

---

(17) R.L. Brown and J. Durbin, 'Methods of Investigating whether a Regression Relationship is constant over time', - Paper presented at the European Statistical Meeting, Amsterdam, September 1968.

changing pattern in the coefficient. The elasticities are derived from the coefficients in the manner described previously.

British and New Zealand lamb, the two principal varieties of this product were subjected to this method of analysis. The results are interesting in that the price elasticity of British lamb was low to begin with but after 1932 starts to rise and reaches a plateau in the last two years, whereas the New Zealand variety starts off high in the twenties and falls sharply to 1932, thereafter remaining constant and relatively low, throughout the thirties.

The results on the income elasticities are interesting too. The elasticities for the U.K. product were not significant even at 10% for the years 1920-'30, '31, '32, '33 and '34. But if there is a pattern discernible it is that the income elasticity started low and finished relatively high. The income elasticity for New Zealand lamb started high and declined at an even rate throughout the period falling from 3.5 at 120-29 to .5 for 1920-1938.

Mutton: The first step was again the simple regression of price on quantity. This yielded a good coefficient of determination for the two home varieties but the equations failed to satisfy the autocorrelation test. As with lamb, it was the introduction of real income and competing substitutes that increased the degree of explanation in the equations. For Scotch mutton, a higher priced variety, the following result shows the consistency desired:

$$\begin{aligned} PSM &= 12.370 - 1.097\ QSM - 1.322\ Y \\ &\quad (1.570) \quad (.365) \quad (.428) \\ R^2 &= .7018 \\ DW &= 1.0011 \end{aligned} \qquad (3)$$

where PSM = Price of Scotch mutton

QSM = Quantity of Scotch mutton per head

Y = Income per head

All estimates are significant at the 1% level, but there is doubt over serial correlation in the residuals.

The cross-price elasticity of New Zealand mutton with respect to Scotch mutton had a negative sign which is not wholly satisfactory, though the magnitude itself was the kind to confirm a priori thoughts that New Zealand mutton would be a close substitute for the home product. Estimates of Argentine and Australian mutton cross-price elasticities were not significant and indeed did not add to the 'explanation' in the equations. Once more the results for the income elasticities have the 'incorrect' sign but the magnitudes are consistent with other results.

English mutton produced somewhat similar results, which is not surprising, it being a fresh meat and not unlike Scotch mutton. One equation was:

$$\begin{aligned} PEM &= 7.047 - 1.562\ QEM + .226\ QNZM \\ &\quad (.881) \quad (.216) \quad (.079) \\ R^2 &= .8227 \\ DW &= 1.7954 \end{aligned} \qquad (4)$$

where PEM = Price of English mutton

QEM = Quantity of English mutton per head

The coefficients are significant at the 1% level, the coefficient of determination is high, and the equation is also free from autocorrelation.

The results for the imported muttons are on the whole poorer than

those for the domestic product. For New Zealand mutton our confidence in the equation was low in view of the poor coefficient of determination and the DW statistic. However, the elasticities derived were not inconsistent with our other results. Unlike lamb, the mutton results degenerated badly in statistical significance when the period was sub-divided. No statement as to trend can be made from the results obtained on either of the two tests on structure.

Beef: Again the simple regressions of price on quantity were run for the different varieties though nowhere did this yield a satisfactory result. Only with the introduction of further variables was a satisfactory level of 'explanation' achieved.

In fact, in all the beef regressions run, both on home produced and on imported beef, the results were very poor. However where elasticities were derived, irrespective of low coefficients of determination, they were invariably of the sign and size we would expect. The results of the sub-periods were equally poor and of no value as they stand. The principal deficiency in both parts of the analysis carried out was the suggestion of auto-correlation. One method of avoiding positive serial correlation in the residuals is to transform the variables to first difference form. Another method of avoiding serial correlation is to introduce the lagged version of the dependent variable as an independent variable.(18) The equation becomes:

$$P_t = a + b_1 Q_t + b_2 Y_t + b_3 P_{t-1}$$

This procedure was adopted for beef and some satisfactory results were obtained.

---

(18) For just one example of the use of this technique, see C.A.E. Goodhart, 'The Importance of Money', Bank of England Bulletin, Vol. 10, No.2, June 1970

e.g.[19]

$$PUKB_t = 7.590 - 1.566\ QUKB_t + .651\ QARB_t - .189\ PUKB_{t-1}$$
$$(1.87) \quad (2.42) \quad (2.33) \quad (2.52)$$
$$R^2 = .4820 \qquad (5)$$

The lagged dependent variable on the right hand side is statistically significant at the 1% level, indicating that there was probably no auto-correlation in the first place. The other variables are also significant at the 1% level. The sign of the price coefficient is correct though that for the cross-price coefficient for Argentine beef is not.

The equations for Argentine beef and Australian beef were both poor. The Argentine result was the better but with a coefficient of determination of only .3596 and the wrong signs obtained for direct and cross-price elasticities we can have little confidence in the results. The coefficients too were significant only at very low levels.

III

The analysis of individual meats invariably showed a weak relationship existing between different varieties of particular meats. This of course should not surprise us. For instance we may expect different meats belonging to the same preservation category (fresh, frozen or chilled) to be closer substitutes for one another than meats of the same type. For example English lamb may have been a closer substitute for English beef than was

---

(19) For these results the t statistic is given in brackets beneath the coefficients and not the standard error. The Durbin-Watson statistic loses its meaning in this test and although 'thrown-up' by the computer it is not presented.

Argentine beef. In view of this all the varieties of meats were ranked according to presumed quality and on the basis of the elasticity estimates obtained above, again concerning quality. In the first group were placed the British meats: beef, mutton and lamb. These were the only fresh meats on the market and were regarded as the best products. We hypothesised that these meats would therefore be close substitutes for each other. In the second group were placed what were thought to be the intermediate quality meats: Argentine chilled beef was regarded as the best imported beef, perhaps even the best imported meat. New Zealand lamb was recognised as the outstanding imported sheep meat. British mutton was also included in this grouping since it was felt it may have been a good substitute for the highest quality imported meats. These varieties therefore made up the second group. In the third category fell the remainder, meats of lower and inconsistent quality.

We can now summarise the results obtained in the regression analysis of the demand for meat by arranging the various parameter estimates in tabular form and comparing the magnitude and signs. Appendix 1 brings together in a rough approximate form, the essence of these results, making some comparison with other empirical work possible.

Ignoring for the moment the question of sign, what is noted is that the income elasticity for most meats is high - greater than one. The exceptions to this are some mutton and lamb types which lie just under one.(20) Price elasticities are generally less than one for the home produced varieties and greater than one for the imported varieties. This is the pattern we would expect. The lower the quality of meat, the greater is the sensitivity to price change, for the greater is the possibility of change to another product. With home produced, fresh, and presumably distinctive varieties of the product

---

(20) See later discussion, pp 19-25.

there is more stability, less likelihood of major switch away from the product for a rise in price. Taking this further we can see that British beefs are the highest quality product, but not far above home produced muttons which in turn are only slightly ahead of home produced lamb. The only imported meat which somes into the category is Argentine beef. We should not of course conclude from the latter's low coefficient that it was the highest quality product of all, simply that it does compare favourably with the best of home produced meats.(21) New Zealand lamb is the only other imported product which, according to the magnitude of the elasticity, approaches the British meats or Argentine beef in quality. This too has support in qualitative evidence.(22)

At the other end of the scale to these products are Argentine mutton, which with its positive sign may even be considered a Giffen good and Australian mutton whose elasticity was too high to consider as seriously belonging to the group. Apart from these, the poorest quality meats were Australian and Argentine lamb, and New Zealand mutton.

Much of the above sorting out of quality by elasticities is simply confirmed by looking at the substitution elasticities,(23) that is, that one top quality product will be readily substituted by another and at the bottom of the quality ladder meats will be readily replaced by one another. For instance in the better quality items, British mutton and British lamb are excellent substitutes and at the other end of the scale Australian beef and Argentine mutton are close substitutes. These latter results certainly clash

---

(21) This is confirmed by contemporary opinion, See e.g. Y.F. Rennie, The Argentine Republic (New York 1945) p.250, 'At Smithfield the highes priced beef is freshly slaughtered meat from Scotland, which goes to the upper class tables; and next in price and quality i.e. Argentine chilled beef selling for two-thirds as much, and the staple diet of the middle class consumer."

(22) H. Belshaw & Others, Agricultural Organisation in New Zealand, (Wgtn 1936) p. 634: 'The Frozen product from N.Z. commands a premium over the Argentine and Australian products, suggesting a qualitive difference in the product'.

(23) See Appendix.

with Stone's[24] which show the home and imported meats of the same variety being highly interchangeable. Our study shows rather that fresh meats were close substitutes for one another. The exceptions are Argentine beef (which was chilled) and New Zealand lamb, the product which took the freezing process best of all.

IV

How do our results compare with other work? Any comparison is fraught with difficulties, various investigators having considered different countries and different periods. Wold and Jureen[25] made estimates for commodities in Sweden both for 1913 and certain inter-war years. Schultz[26] and Fox[27] made estimates based on American data for 1922-33 and 1922-41 respecitvely. Stone[28] made estimates for the U.K. for 1920-1938 and Philpott and Matheson[29] produced estimates for the U.K. for 1955-64. Josling's[30] study was also of the U.K. for the 1960s. Few of these studies used similar classifications of meat, but even if they had been using strictly comparable data, differences in income levels between time periods and between countries for the same period, differences in climate, custom and so on all influence income elasticities.[31]

---

(24) J.R.N. Stone, The Measurement of Consumers' Expenditure and Behaviour in the United Kingdom 1920-1938, (Cambridge, 1954). But Stone did not test this fully.

(25) H. Wold and L. Jureen, Demand Analysis : A Study in Econometrics, (New York, 1952).

(26) H. Schultz, The Theory and Measurement of Demand, (Chicago, 1938)

(27) K. Fox, Econometric Analysis and Public Policy, (Iowa, 1958)

(28) J.R.N. Stone, op.cit.

(29) B.P. Philpott and Mary J. Matheson, An Analysis of Retail Demand for Meat in the United Kingdom, (Lincoln N.Z. 1965).

(30) T. Josling, unpublished estimates, (1970), (available from the author)

(31) e.g. Wold, op.cit., p.277 showed that pork in Sweden had a significantly different elasticity to that of U.S.

However there are certain similarities in the results, and where patterns are discernible, there are interesting pointers for further work. Fox, for example, points out that as national income during the inter-war period was fluctuating around a much lower 'real' level than exists in the years after 1945, income elasticities should be larger in the former period.(32) Wold came to the same conclusion, i.e. that income elasticity for food presents a clear tendency to decrease as income grows. Against this, Wold in separate cross-sectional studies found similar income elasticity estimates for the years 1913 and 1933 though he did point out that 1913 was a prosperous year and 1933 a depression year.

A further complication in the comparison is that some estimates have been based on cross-sectional data (usually family budget surveys) while others have been based on time series data. Harberger has criticised Stone for assuming that cross-sectional and series income elasticities are the same.(33) Harberger considers it wisest to estimate price and income elasticities from time series data: "I would place greatest faith in estimates which are corroborated by the results of a strictly time series demand analysis where conditions of collinearity make this possible."(34)

The Appendix sets out the various estimates of some principal investigators. What stands out from the table is that income elasticities fall mainly in the range +.30 to .70. Stone's results are clearly of most interest to this study, though he simply made estimates for 'home' produced beef and veal (lumped together) and home produced mutton and lamb (lumped together). He then assumed the imported variety to be virtually the same. Philpott's estimates for beef and veal for 1955-64 do not entirely fall into the pattern

---

(32) Fox, op.cit., p.126.

(33) A.C. Harberger's Review of Stone's Study, Econometrica, 1955, p.218.

(34) Harberger, op.cit.

of declining elasticities with increased incomes, being higher than some of Stone's. Wold's estimates include negative signs, though the magnitude following such a sign is not large and the range runs to a much greater positive coefficient. Josling's estimates[35] based on almost identical data to that of Philpott, (for the same period approximately and in the United Kingdom, using retail prices) are as we would expect very similar. The most interesting results here is the negative coefficient for mutton suggesting an inferior product.[36]

Bergstrom estimated the British demand for New Zealand lamb in the interwar period[37] and he too obtained a negative income elasticity:

> "The negative income elasticity of demand for lamb is, at first sight, surprising. It should be remembered, however, that New Zealand lamb is frozen and is likely, therefore, to be regarded by United Kingdom consumers as an inferior substitute for fresh, home produced lamb. Thus it is quite conceivable that an increase in the real incomes of United Kingdom consumers would, if all prices were held constant, cause a reduction in the demand for New Zealand lamb. In fact of course prices would not remain constant, and an increase in the United Kingdom real income would, by forcing up the price of fresh lamb, cause an increase in the demand for New Zealand lamb".

Empirical results conflict, some like Bergstrom and Schmidt suggesting support for our results while others are in opposition.

The cautions applying to the comparison of income elasticities are

---

(35) T. Josling, unpublished estimates. Available from the author.

(36) This may well be the case for the years discussed when there has been a move back to beef and increasingly to lamb and away from mutton. Rainer Schmidt, "Econometric Analysis of Prices in the International Beef Markets" (unpublished paper 1970), available from the author, found a negative income elasticity for beef in Argentina and explained it by the fact that there was a very high per capita consumption of beef but a campaign to increase demand for lamb and so release beef for export.

(37) A.R. Bergstrom, 'An Econometric Study of Supply and Demand for New Zealand's Exports", Econometrica, 1955, pp.258-271.

equally applicable to a comparison of price and cross-price elasticities. Some of the principal findings of the investigators mentioned above have been collected and are presented in Appendix II. Once again the classifications of meat are not ideal for our purposes but the results are nevertheless useful.

Leaving aside Philpott's and Josling's work for the moment and looking at the three studies made for interwar years, we find price elasticities usually of less than one. The only exception in fact to this is one of Stone's estimates for home produced mutton and lamb, which is -1.74, and the estimates of Schultz again for mutton, though probably incorporating lamb. The latter estimate is highest of all at -2.35. These are interesting results. They show that mutton was the product, both in the U.K. and the U.S. which was most sensitive to price change. It was highly price elastic as against the relatively inelastic beef, veal, pork, etc. At this point too it should be noted that aggregate price elasticities are always lower than disaggregated forms. Thus we could expect many of the results given (e.g. by Stone) to increase in size possibly becoming greater than unity if we broke down the classification of meat. We may then get a very high figure for different muttons in the U.S. from Schultz's figures.

Coming to Philpott's figures the first feature of note is that the magnitudes are all greater than unity and considerably greater than the other results. This may be explained in terms of the relative affluence of the fifties and the accompanying vastly improved range of products in the market and the greater possibility of substitution.(38) The other point of doubt lies in the relatively higher beef and veal coefficient, than the mutton and lamb coefficient.

---

(38) Philpott's estimates are based on retail data and therefore likely to yield higher estimates.

V

An examination of the contemporary evidence is of most interest for the light it can cast on the negative income elasticity. A number of features emerge from the evidence suggesting that we should at least be cautious in rejecting the negative result. It is perhaps worth stressing that a simple comparison of per capita consumption and per capita income over the period does not solve the problem for it was precisely this question of separating the effect of income and prices that was tackled in the regression analysis. What such a comparison shows however, using total population, is growing per capita income but almost static per capita consumption of the meats we tested. Further, if we hypothesise that the meat-eating population was more accurately specified at ages 15-64 inclusive[39] we find per capita consumption levels rising, and this in spite of falling incomes. In any case there is no need to be shy of the notion of meat being an inferior good. There are many other examples of such results.[40]

There may be a problem in that the meat we are considering may have been eaten primarily by the middle classes. If this were the case[41] we might hypothesise that with meat consumption levels already high in this group,

---

(39) J.R.N. Stone, op.cit.

(40) The Ministry of Agriculture's published estimates of income elasticities for various meats in recent years has shown beef to be in this category on occasions: Household Expenditure Surveys, 1962 pp. 116/7. T. Josling in unpublished estimates found mutton to be 'inferior' in the U.K. during the 1950s and 1960s. A.R. Bergstrom found New Zealand lamb in the inter-war years to be inferior, "An Econometric Study of Supply and Demand for New Zealand's Exports", Econometrica, 1955 pp. 285-271. Rainer Schmidt, "Econometric Analysis of Prices in the International Beef Markets" (unpublished paper 1970) also obtained the same result for beef in Argentina in the 1960s.

(41) The sort of evidence that we would adduce for this is that it was in the upper range of the price distribution and the type of statements made by, for instance Critchell and Raymond, A History of the Frozen Meat Trade (London 1921), p.317.

they, with rising real incomes, opted for new possibilities in consumption both in food and non-food goods.(42) Burnett says the middle class of the inter-war years was swollen by the growth of professional classes and was far bigger than it had been in 1914 but that it was poorer.(43) This can mean a number of things but if we take it to mean, as would seem most reasonable, that each family unit was at a lower level compared with its pre 1914 counterpart even though its real income was slowly rising then when, as Burnett says, it had to economise on domestic service and other luxuries we may fairly suggest that our meats may well have fallen into this category. For while it is generally true that as incomes rise more protein foods are eaten it may not be true for the inter-war years. What we require ideally, in order to demonstrate the veracity of this assertion, is some study of middle-class eating habits comparable to the surveys carried out of the working classes. There is one study of the middle-classes(44) but it is not very useful on food expenditure.

In the absence of such evidence perhaps we can find some clues as to the sign of the income coefficients in an examination of working class expenditure patterns. The surveys of living standards that do exist focus on the poorest section of the community and mostly purport to show that high levels of malnutrition existed and that a large percentage of the population was below a poverty level variously defined. For example the Percy Ford survey of Southampton in 1931 showd more than 20% of that flourishing seaport below the intolerable 'Bowley line'.(45) The Reading Survey of 1924 had

---

(42) John Burnett, Plenty and Want, p.291 talks of the enormous range of new foods available though it is difficult to accept his statement: "what most people wanted was imported crab and peaches for Sunday tea".

(43) Burnett, op.cit.

(44) P. Massey, "The Expenditure of British Middle-Class Households in 1938-39", JRSS, Pt.II, pp. 159-196.

(45) P. Ford, Work and Wealth in a Modern Port (1931) using the budget laid down by Bowley in 1924, in Has Poverty Diminished?

shown 12% below this line and one for Merseyside, admittedly in the worst years of the depression, showed 16% below the Bowley line - equivalent to 29% below Rowntree's poverty line.(46) While it should be noted that most of these surveys took place in depression years they were not (excepting perhaps Merseyside) depression areas. Much contemporary literature also stressed the bleakness of life and the low levels of welfare.(47) It has been estimated that about eight million people spent less on food than that regarded as minimal by the British Medical Association in its 'Report of the Committee on Nutrition'.(48) And Titmuss says that if Orr is right, only 50% of the British population were receiving a diet adequate for health and physical well being.(49)

The surveys mentioned above invariably demonstrate that because of low incomes (either from unemployment, irregularity of employment or low wages) nutritive foods were not consumed in sufficient quantitites and of course they implicitly or explicitly point to a positive income elasticity, i.e. if incomes rose so too would meat consumption. Some of them purport to show this in a cross-section study but some cautions are necessary. In the first place some of the cross-section work is contradictory. Secondly many of the investigations took place at different times of the year and ignore the very important factor in food expenditure - seasonality. And of course they leave out of account other influences on expenditure such as tradition.

Take first Rowntree's survey in York in the middle of the 1930s. Rowntree claimed that York was a town representative of the country as a whole

---

(46) Quoted in G.D.H. Cole and M.I. Cole, The Condition of Britain, (Gollancz, 1937).

(47) See e.g. Allen Hall, The Condition of the Working Class in Britain (1933). This book is written from an avowedly Marxist standpoint and follows in the style of Engels of 1844. It supports the gloomy picture of the social surveys by filling in details of life in South Wales, Clydeside, Lancashire and London.

(48) B.M.A. 1933 quoted in R.F. George, 'A New Calculation of the Poverty Line', JRSS 1936, p.77.

(49) R.M. Titmuss, Poverty & Population, (London 1939), p.230.

("On the whole, I think we may safely assume that from the standpoint of the earnings of the workers, York holds a position not far from the median, among the towns of Great Britain")(50) and found huge numbers below his "human needs standard". In a cross-section study of different income groups, Rowntree presents four typical budgets showing food expenditure in one week. If we extract the meat consumption from these four typical budgets we have the following Table:(51)

Meat Consumption in Different Income Groups

Group I	Group II	Group III	Group IV
June & September	August	May	April/May
36/-/week	41/8/week	72/-/week	75/-/week
2lb roast beef	4½lb roast beef	½lb stewing steak	2½lb mutton
½ liver	1 stewing	½ best steak	2 rabbit
½ mince	1½ sausage	2 rabbit	½ tripe
½ sausages	1 liver	1 sausages	1 pork sausages
½ pie	½ corned beef	¼ pork	¼ corned beef
½ bacon	1½ bacon	½ ham	¾ liver
		1 bacon	6ozs ham
		1 liver	¼ brawn
		1½ hearts	¼ polony
			½ bacon

Rowntree himself warns against strict comparison of these budgets because of the lack of seasonal uniformity. But it is interesting to note

---

(50) B. Seebohm Rowntree, Poverty and Progress, (Longmans, 1952), p.10.

(51) Rowntree, op.cit., pp. 188-194. At the top of each group is shown the family income.

that in this cross-section of income groups there is no clear evidence in support of a positive income/consumption coefficient for the meat we consider. In fact the evidence is rather against such a conclusion. In the highest income group there is less of our meat being bought than there is in the second lowest income group. What is evident though is a move to greater variety in "meat" consumption as income grows; the list of items lengthens as we move across the income scale with some of our meat being given up and other categories being introduced. We are not suggesting here that this is in any way conclusive evidence in our favour - especially in the light of the caution we have already made about the sample - simply that it does fly in the face of generalisations that are made about this relationship: "increased purchasing power resulted in greatly increased consumption of ... meat, butter, eggs, fruit, vegetables".(52)

One of the most celebrated studies of the 1930s was that of John Boyd Orr.(53) Orr states "consumption of milk, eggs, fruit, vegetables, meat and fish rises with income".(54) And yet there are contradictions in his study. For example he says "consumption of milk ... does not appear to have been lower a hundred years ago and in rural areas was possibly higher".(55) In other words consumption of milk (in the same quality bracket as meat) has fallen or remained static over a period of rising incomes. Then again in Orr's cross-section studies he does show meat consumption to be higher in higher income groups but there are two points we should stress. The first

---

(52) Burnett, op.cit., p.285, He doesn't say what kind of meat.

(53) John Boyd Orr, Food, Health and Income (Macmillan, 1936). This study has been criticised for having an undue proportion of families from the North of England and of families of low earnings.

(54) Orr, op.cit., p.49.

(55) Orr, op.cit., p.17. In fact Burnett goes further than this when he makes his statement, "milk was an even better example of the fact that consumption of the most nutritionally desirable foods varied inversely with income", this though would appear to be a mistake on his part, Burnett, op.cit., p.318.

and very important one for our purposes is that he doesn't say what meat is included and we cannot therefore accept this as contrary to our findings. The second point is that he gets the same results for potatoes which of course is against all the conventional wisdom on potatoes being the classic example of an inferior good (even a Giffen good).

Further evidence along these lines is suggested by Lloyd.(56) He showed in 1936 how consumption of meat had increased only slightly by 1934-38 compared with 1909-13 and 1924-28 but that the increase was mainly in bacon and offal, supporting our earlier point and the evidence in Rowntree's typical budgets. He posed the question as to whether this was due to growing popularity of liver and bacon or to medical recommendation of liver as a cure for anaemia.(57) Thus we have not any clear evidence from the family budget surveys of the working classes that consumption of the meat we are dealing with rose or fell with income.

There are other pieces of evidence that lend support to the apparent paradox of negative income elasticity which we achieved in our results. For instance in the middle classes there undoubtedly was a move to vegeterianism. We have already mentioned the fact that there was increased consumption of bacon and liver for health reasons. There was also a decline in the quality of British beef attributed to the growing percentage dairy cattle made up in total supply,(58) and hence on pressure for reduced consumption. These factors

---

(56) E.M.H. Lloyd, Journal of the Proceedings of the Agricultural Economics Society, 1936, Vol. IV No. 2. Also quoted in J.C. Drummond and Anne Wilbraham, The Englishman's Food, (1964), p.457.

(57) Sir Wm. Crawford in The People's Food (Heinemann, 1933) made the same point: "A greater appreciation of the food value of offals (kidney, liver, etc.) has certainly grown up in recent years, stimulated by the medicinal uses to which they are now put", p.189.

(58) Viscount Astor and B. Seebohm Rowntree, British Agriculture, The Principles of Future Policy, (Pelican, 1939), p.153.

all point to a movement, however slight, away from certain of the meats we have been considering.

A further factor supporting our results is that of conservatism in the consumer. Burnett says, "advertisers would do well to recognise the force of dietary conservatism which it seems, expensively mounted campaigns can influence only marginally".(59) Changes in taste in food take place relatively slowly even with rising incomes, and in any event the growth of income in these years came only after 1924 and was severely interrupted between 1929 and 1932.

There are then several possible explanations of negative income elasticities. It may be that sections of the population ate little of the meat we tested and the section that did had new opportunities for spending. It could be that whereas meat consumption was a status symbol in the nineteenth century for the wage-earning classes and we could expect to observe meat consumption rising with real income, this need not have been the case for the inter-war years when the status items had changed.(60) Any evidence of an increase in the standard of living or an improvement in nutrition does not negate what we have said if we do not know precisely how the improvements came about.(61)

---

(59) Burnett, op.cit., p.316.

(60) Burnett has suggested some of the foods which may have been purchased. Non-food goods might include cigarettes and the cinema.

(61) As suggested for instance by Sidney Pollard, The Development of the British Economy 1914-1950, (London, 1962), p.293.

APPENDIX I

Derivation and Presentation of the Elasticities

The conventional form of the equation is:

$$q_t = c + dp_t + eY_t$$

reversing this gives:

$$dp_t = -c + q_t - eY_t$$

$$p_t = -\frac{c}{d} + \frac{1}{d}q_t - \frac{c}{d}Y_t$$

thus the price elasticity is $\frac{1}{d}$, or the reciprocal of the quantity coefficient in the equation, the income elasticity is $\frac{c}{d}$ and any cross price elasticity would be $\frac{b}{d}$.

e.g. from equation (1) in the text we have

$$d = .832 \quad \text{i.e.} \quad \frac{1}{d} = \frac{1}{.832} = 1.202$$

$$b = .427 \quad \text{i.e.} \quad \frac{b}{d} = \frac{.427}{.832} = 0.513$$

Derived Elasticities*

Equation	Price elasticity		Cross price elasticity		Income elasticity
1	BL	-1.202	NZL/BL	+0.513	
2	AUL	-3.389			-2.495
3	SM	-0.912			+1.205
4	EM	-0.640	NZM/EM	-0.672	
5	UKB	-0.641			

* the equation numbers are those given in the text.

APPENDIX I

Price and Cross-Price Elasticities

Meats	Direct Price Elasticity	Cross-Price Elasticities		
		British Lamb	British Mutton	British Beef
Beef:				
British	- .573	+1.844	-1.054	
British	- .585	+1.582	- .793	
British	- .499	+1.355	- .645	
Lamb:				
British	- .503		- .189	+ .471
Mutton:				
British	+1.181	+5.242		-1.371

Meat	Direct Price Elasticity	Cross-Price Elasticities					
		AUL	AUM	ARM	ARL	NZM	NZB
*							
AUB	-			+2.967			
AUB	-2.193					-1.393	
AUM	-4.695				+3.094		
NZM	-3.984	+1.323			+1.406		
ARL	-1.712		+ .324				
ARL	-1.712		+ .337				

where AU is Australian
AR is Argentinian
NZ is New Zealand

APPENDIX II

Income Elasticities

Beef	Mutton	Lamb
UK -1.5	SC +1.5	UK - .8
UK - 1.5	EN - .9	
UK - 1.5	AU - .4	NZ - .6
AR - 2.5	NZ - .6	AU - 2.5
AU > -3.0	AR -	AR - 4.5

Direct Price Elasticities

Beef	Mutton	Lamb
UK - .5; - .6	SC - .8	UK -1.0
AR - .3	EN - .7	
AU -2.0	AU Too high	AU -2.5
	AR Pos sign	AR -3.0
	NZ -4.0	NZ -1.2

Cross Price Elasticities

(a) Between meats of same type

Lamb		Mutton	
UKL/NZL	.5	SCM/NZM	.3
ARL/NZL	.2	ENM/NZM	.7

(b) Between meats of different types

Quality A		Quality B		Quality C	
UKL/UKB	.5	UKM/NZL	1.3	AUB/ARM	3.0
UKM/UKL	3.0	ARB/UKM	.36	AUM/ARL	3.0
		NZL/UKM	.5	NZM/ARL	1.4
				ARL/AUM	.3

APPENDIX III

Comparison of Various Estimates of Income Elasticities of Demand

MEAT TYPE	STONE	JOSLING	PHILPOTT	FOX	SCHULTZ	WOLD (i)	WOLD (iii)	
All Beef					.481	.29	-.05	.64
All Veal							-.13	.90
All Mutton					.185			
All Pork	.58	.578			.542	.35	.18	.80
Beef/Veal		.752	.43					
Mutt/Lamb		-0.088	TOO LOW					
B/V Imptd.*	.34							
M/L Imptd.*	.70							
B/V Home*	.34							
M/L Home*	.70							
Bacon/Ham		-0.001						
All Meat			.50	.51			.30	
Meat/Poultry/ Fish				.23				

Sources:
1. Stone op cit. Stone estimated for the 'home' item and then used for the imported.
2. T. Josling, unpublished estimates 1971.
3. Philpott, op. cit. 1954-1964.
4. Fox, op. cit. Family Budget data 1948.
5. Shultz, op. cit. 1922-33.
6. Wold, op cit. column (i) shows aggregate estimate over 1920-39, column (ii) shows that of industrial workers in 1933.

* B/V = Beef/Veal M/L = Mutton/Lamb Imptd. = Imported

APPENDIX III

Comparison of Various Estimates of Price Elasticities of Demand

MEAT TYPE	STONE	WOLD	SCHULTZ	JOSLING	PHILPOTT
All Beef		.22*	- .8576		
All Mutton			-2.3531 -1.7951		
All Pork	-.67	.31*	- .7009	-2.37	-1.63
Beef/Veal				-2.49	-2.02
Mutton/Lamb				- .006	-1.37
B/V Imptd.+	+.55 -.46				
M/L Imptd+	-.43 -.82				
B/V Home+					
M/L Home+					
Non Carcase Meat					- .63
Bacon/Ham				- .001	
Poultry					-2.53
All Meat		.26			

Sources: as quoted in works previously used.

* Wold does not explain the positive sign and we assume it was simply a convention to show the magnitude. When quoted by C. E. Ferguson, Microeconomic Theory (IRWIN, 1969), it has a negative sign.

\+ B/V = Beef/Veal M/L = Mutton/Lamb Imptd. = Imported

APPENDIX III

Comparison of Various Estimates of Cross-Price Elasticities

MEATS	STONE		
	Imported Mutton/Lamb	Home Beef/Veal	All Mutton/Lamb
B/V Home	+.50		
B/V Imptd.		+1.67	
M/L Home		+1.61	
M/L Imptd.		+1.94	
Pork			+.85

	SCHULTZ					
	Beef		Pork		Mutton	
Beef	-		+.096	+.121	+.201	+.244
Pork	+.194		-		-.004	-.606
Mutton	+.635	+.698	+.367	+.677	-	

	JOSLING			
	Beef	Pork	Mutt/Lamb	Bacon/Ham
Beef	-	.52	.72	-.0079
Pork	.74	-	.61	-.0061
Mutt/Lamb	.58	.26	-	.0009
Bacon/Ham	.010	-.202	.008	-

	PHILPOTT	
	Non Mutt/Lamb	Non Beef/Veal
Mutt/Lamb	+1.29	
Beef/Veal		+.47

Sources: As previously given.