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Butter
University of Reading
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THE DEMAND FOR BUTTER IN THE NETHERLANDS

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THE DEMAND FOR BUTTER
IN THE NETHERLANDS

by

M.Upton & J.I.Wittenberg

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1. Introduction

Butter is clearly a key commodity in the operation of the Common Agricultural Policy. Butter lends itself to cold storage and represents a simple method of utilizing milk fats. Hence, it is in this form, together with dried skim-milk powder that buffer stocks of dairy products are held.

From the early 1960's there has been a tendency for the production of dairy products to exceed consumption, initially among the six and later in the enlarged community. As a result, periodical butter surpluses have proved to be an embarrassment. In-so-far as the Common Agricultural Policy has a social element, that of supporting incomes of small farmers, and in-so-far as dairying is the typical activity of small farmers, the Community cannot readily allow margins in dairying to fall drastically. Hence, current rates of average annual supply of butter could well be maintained in the future.

Obviously information on the likely changes in the demand for butter in future and the effects of retail price adjustments are of crucial importance in guiding future policy. It was therefore decided that the Department of Agricultural Economics at Reading University would embark on a programme of studies of factors influencing the demand for butter in the nine countries of the enlarged common market. This present study of the demand for butter in the Netherlands is intended as a pilot study for the larger programme.

The Netherlands was chosen as a country outside Britain where we already had good contacts, where there are few problems of communication, the Dutch being good linguists, and where relatively limited travel costs were involved.

The authors visited Rotterdam and the Hague early in October, 1973 to collect facts and data. Helpful discussions were held at:

- (1) Landbouw - Economisch Instituut (L.E.I.), the Agricultural Economics Research Institute for the Netherlands
- (2) Produktschap voor Zuivel (P.Z.), the Commodity Board for Dairy Produce and
- (3) Nederlandse Unilever Bedrijven B.V., the largest margarine manufacturer in the Netherlands.

In the course of these discussions general information on the Netherlands' butter market was obtained and available data sources were explored.

It was found that very little recent quantitative work had been published on the demand for butter in the Netherlands. We were made aware of two studies which had recently been carried out.

- (i) Mr. C.Bos, at the L.E.I., has recently attempted to estimate a demand function for butter using an annual Houthakker model.* His results are now in the hands of the European Commission and will be published sometime in the future.
- (ii) B.Wierenga (1969), "Quantitative Research on the Demand for Butter in the Netherlands." Maandschrift Economie 33e Jaargang No.9.

This study attempted to estimate demand functions for both fresh and cold-store butter, using four-weekly N.I.A.M. consumer panel data. (Nederlands Instituut voor Agrarisch Marktonderzoek.)

* Houthakker, H.S. (1957). An international comparison of household expenditure patterns. Econometrica, 25 p.532-552.

2. Butter Consumption in the Netherlands

In comparison with most other European countries, the annual per capita butter consumption of the Dutch is low, and their margarine consumption high. Average butter consumption is estimated to be about 2 kilogrammes per head per year, while average margarine consumption is estimated at 18 kilogrammes per head.

It is thought that the low level of butter consumption may be the result of the combination of several effects:-

(i) Price of Butter

The high price of butter, particularly in relation to the price of margarine which is among the lowest in the E.E.C.*

(ii) Consumer Habits

Consumer habits are, in some cases, thought to be a residual effect of the last war. During that time very little butter was available and the populace was forced to use margarine. To some extent the habit of using margarine rather than butter remained after the war.

(iii) Possible health hazards

It is widely believed in the Netherlands that the consumption of butter (and other products containing cholesterol) may be associated with cardiovascular diseases, hence many people, particularly those in the middle classes, favour low cholesterol margarine and spreads for health reasons.

* 1973 - Average butter price £1.30 (7.80 guilders) per kg.
Average price for ordinary margarine 28p. (1.68 guilders) per kg.
Average price of "easy-spread" and low cholesterol margarines 54p.
(3 guilders) per kg.

This influence is probably small, since five years ago before interest was aroused in possible health hazards, butter consumption was already low.

(iv) Price response ratchet effect

Although butter (and margarine) prices have been relatively stable for the past few years, previously fluctuations have been observed in the historical price series. It is estimated that consumer response is greater to rising prices than to falling prices. Thus, the price elasticity of demand for butter when prices are rising is estimated to be around -1.8, whereas when prices are falling the elasticity is suggested to be around -0.4. This means that if prices rise and subsequently fall, consumption does not return to the original level. However, it should be noted that there have been relatively few occasions when butter prices have fallen so that the latter estimate can only be considered as tentative. One possible explanation of the difference between the elasticity of demand associated with a rise in price and that associated with a fall is that there may be a longer lag in the response to falling prices rather than a different long-run elasticity.

3. Other features of the Netherlands' butter market

(i) Smuggling

Apart from official exports a certain amount of butter purchased in the Netherlands is consumed outside the country. On the one hand, up to 1968 substantial quantities of butter were bought in the Netherlands to be smuggled into Belgium. It is estimated that when

this smuggling reached its peak in 1968, around 20,000 tonnes of butter, or about one fifth of total butter sales, left the country in this way. However there are no reliable statistics on the extent of the smuggling operation, and this illicit trade is included in the domestic consumption figures for the Netherlands.

On the other hand, there exists a certain amount of legitimate frontier trade - in particular German housewives may visit Holland to buy food, including butter, which they are allowed to take back across the frontier free of duty.

(ii) Cold Store butter

On several occasions in the past, stocks of butter have been released from cold storage on the domestic market under authority from the European Commission in Brussels. This butter is clearly labelled "cold-store butter" and is sold at a much lower price than fresh butter. The main effect of this policy has been the substitution of cold-store butter purchases for fresh butter purchases, accompanied by an increase in the total amount of butter sold. It has been suggested that this substitution effect has a marked seasonality. In March, each kilogramme of cold-store butter sold reduced fresh butter sales by 600 gms., whereas in December the rate of substitution was 1 kg. of cold-store to 800 gms. of fresh butter. Clearly there is a strong interrelationship between the cold store and fresh butter which must be considered in any study.¹

1 Wierenga, B. (1969) Op.cit.

(iii) The margarine market

Most of the margarine purchased in the Netherlands is produced by Unilever (estimates of their share of the market range from 50 - 90%), probably around 70%. The rest of the market is satisfied by a few, smaller, firms. Types of margarine available may be classified into the following categories:

1. Cooking
2. Table
3. Health

Data are available on the consumption of each of these separate types.

4. The Regression Models

On the basis of this information we assume that butter consumption per head C_t is determined by

1. The price of butter, P
2. The price of substitute products, where the price of margarine, P_m , is by far the most important.
3. Income per head, I .
4. Possibly a time trend t .

Thus we might assume;

$$C_t = f(P, P_m, I, t)$$

However, special conditions arise because cold store butter is often available at a lower price, in addition to fresh butter. Hence we may use three alternative models;

for total butter consumption (1) $C_t = f(P_g, P_m, I, t)$

for fresh butter consumption (2) $C_b = f(P_b, C_k, P_m, I, t)$

for cold-store butter consumption (3) $C_k = f(P_k, P_v, P_m, I, t)$

Where: C_t = total butter consumption
 C_b = consumption of fresh butter
 C_k = consumption of cold-store butter
 P_g = average weighted price of butter
 P_b = price of fresh butter
 P_k = price of cold-store butter
 P_v = price difference between fresh and cold-store butter.

It was not considered necessary to use simultaneous - equation methods since the independent variables in the above equations appear to be determined exogenously. The prices of fresh and cold-store butter are determined by government policy, not by the functioning of a free market. The margarine industry takes little account of butter consumption in establishing margarine price because butter makes such a small proportion of the total spreadable fats consumption. Per capita income can also be regarded as virtually independent of butter production. In its influence on fresh butter consumption, the consumption of cold-store butter may be viewed as predetermined. Thus ordinary least squares (OLS) methods of estimation were used.

The analysis was based on time series data. Three different approaches were used in estimating the coefficients of the demand functions:

- (i) Ordinary linear regression on the untransformed variables.
- (ii) Where the Durbin-Watson "d" statistic was found to be significant, first differences were used in an attempt to reduce the autocorrelation. Also the Cochrane-Orcutt iterative process was used in an attempt to eliminate first order autocorrelation. *

* See Johnston J. (1972) Econometric Methods 2nd. Ed.

- (iii) A distributed lag model incorporating the dependent variable lagged 1 time-period as an independent variable.

5. The data

For our research we made use of unpublished data obtained from the NIAM consumer panel made available to us by the Produktschap Zuivel; as did Wierenga in his earlier study (op cit). The data used were obtained at 4 weekly intervals over the period from 10th September 1966 to 8th September 1973.¹ Thus there were up to 92 points (observations) in total, on each of the following variables.

- (1) C_b - quantity of fresh butter (in kilos) bought per 100 reporting households
- (2) C_k - quantity of cold-store butter (in kilos) bought per 100 reporting households
- (3) C_t - total quantity of butter (in kilos) bought per 100 reporting households.
- (4) P_b - average consumer price paid for fresh butter in cents/250 grams.
- (5) P_c - average consumer price paid for cold-store butter in cents/250 grams.
- (6) P_g - weighted average consumer price for all butter, in cents/250 grams; weights based on relative quantities of fresh and cold-store butter purchased by reporting households.

The incomes of the NIAM panel members are unknown, hence aggregate national income figures were used.

In addition data for the following variables were provided by Nederlandse Unilever Bedrijven B.V.

- (7) P_m - price of margarine (usually table margarine) in cents per 250 grams.

¹ Not all series were available for the entire period.

- (8) N = National income in million florins.
- (9) I = National income per capita - obtained by dividing national income in millions florins (N) by the population in millions.
- (10) R = index of retail prices (1964 = 100)

In addition a time trend was incorporated into some of the regression equations by numbering the observations from 1 up to 92 and treating these numbers as an additional variable 't'. Seasonal variations were taken into account by incorporating 3 dummy variables;

D₁ having the value 1 for periods 4-6 and the value 0 for all other periods in each year.

D₂ having the value 1 for periods 7-9 and the value 0 for all other periods in each year and

D₃ having the value 1 for periods 10-13 and the value 0 for all other periods in each year.

The prices of butter and margarine (variables 4, 5, 6 and 7) and the national income variables (variables 8 and 9) are all measured at their actual money values although in empirical demand analysis it is customary to work with real prices and real incomes. However it is arguable that, except in periods of rapid inflation, consumers react to changes in money incomes and prices and are much less conscious of changes in the real purchasing power of those incomes.* However by incorporating the retail price index in some of the regressions, we have taken variations in the purchasing power of money into account. With the retail price index included as an independent variable the partial coefficients for butter price, margarine price and per capita income, represent the effects of variations in their real values.

* The use of money prices and incomes, rather than real prices and incomes, in demand analysis is justified more fully by:

Koutsoyiannis, A.P. (1963) Demand functions for tobacco

The Manchester School

reprinted in Wagner, L. & Baltazzis, N (eds.) (1973) Readings in applied microeconomics. The Clarendon Press and the Open University.

In studying the demand for fresh butter two alternative approaches were used:

- (i) Using the data for all periods in which the quantities of fresh and cold-store butter consumed are recorded separately (87 periods) and ignoring the consumption of cold-store butter.
- (ii) Separating these periods when cold-store butter was available (47 observations) from those when it was not available (38 observations) and running separate regressions for each set of observations. For the periods when cold-store butter was available the quantity consumed is included in the regression as an independent variable. Analyses of the demand for cold-store butter were based only on those periods when it was available. In the event the estimates of the demand equation for cold-store butter were unsatisfactory in that they "explained" a relatively small proportion of the variation in cold-store butter consumption. However, we are not really concerned with the demand for cold-store butter alone but rather with the effect of sales of this commodity on the demand for fresh butter. Hence we will not present the results of the regression for cold store butter alone.

6. Results

The results of selected demand function estimates for total butter consumption are given in Appendix Table 1. Estimates for fresh butter consumption are given in Appendix Table 2. It is noteworthy that the use of first differences and of the Cochrane-Orcutt iterative process were unsuccessful in reducing first order autocorrelation in any of the equations. Hence we only present ordinary least squares regressions on untransformed variables, in Appendix Tables 1 and 2.

a) The influence of butter price.

For total butter consumption the partial regression coefficients on the average butter price are all significantly different from zero. Furthermore they are remarkably stable ranging from $-.09$ to $-.19$. As one would expect the sign of the coefficient is always negative. Equation 12 with a coefficient of $-.16$ is considered to be the most satisfactory relationship in terms of significance levels of the equation and the individual coefficients, and the absence of autocorrelation.

For fresh butter consumption the partial regression coefficients on fresh butter price are all significantly different from zero, and are all negative. However, they are somewhat less stable ranging from $-.26$ to -1.09 and are clearly much larger than the price coefficients for total butter consumption. This result is not surprising. In periods when cold-store butter is available it may be substituted for fresh butter when the price of the latter rises. We would therefore expect the demand for fresh butter to be more elastic than the overall demand for butter of both kinds. For fresh butter the most useful equations were thought to be:

equation 23 - covering the whole period and ignoring cold store butter consumption.

equation 25 - covering those periods when cold store butter was available and treating cold-store butter consumption as an independent variable.

equation 28 - covering those periods when no cold store butter was available.

Estimates of the price elasticities of demand for butter based on these equations are given in Tables 1 and 2. A comparison of the elasticity estimates in these two tables appears to suggest that the demand for butter has become more responsive to changes in prices and incomes in recent years.

Table 1

Elasticities of demand - estimated at point of means

	<u>Price elasticity of demand</u>	<u>Income elasticity of demand</u>
All butter	- .96	*
Fresh butter (all periods)	- 2.47	.59
Fresh butter (cold-store butter available)	- 2.05	*
Fresh butter (cold-store butter not available)	- 2.97	*

Table 2

Elasticities of demand - estimated at terminal points (1972/73)

	<u>Price elasticity of demand</u>	<u>Income elasticity of demand</u>
All butter	- 1.59	*
Fresh butter (all periods)	- 3.35	0.97
Fresh butter (cold-store butter available)	- 5.71	*
Fresh butter (cold-store butter not available)	- 3.96	*

* Estimates unreliable due to inclusion of time trend - highly correlated with national income per capita.

b) Influence of Cold-store butter sales

From equations 24 and 25 the partial regression coefficients for the quantity of cold-store butter are -.66 and -.62 respectively. This implies that each kilogram of cold-store butter sold reduces fresh butter sales by between .6 and .7 of a kilogram.

Our estimate is somewhat lower than the .8 kilogram reduction in fresh butter sales estimated by Wierenga in the 1960's.

c) Influence of margarine price

Where the partial regression coefficient for margarine price was significant it was generally found to be negative. This result, which implies that when the price of margarine rises the consumption of butter falls, is a little surprising. However Wierenga in his earlier study found the same result. His explanation is that the consumer earmarks a constant sum of money for the purchase of spreadable fats. If the price of margarine rises, the consumer will restrict his purchases of butter to keep within his expenditure limitations. It should be pointed out, however, that this does not necessarily imply that margarine has a positive own-price elasticity (Giffen paradox).

d) Time Trend and Income Effects

National income per capita is strongly correlated with time; there is a steady upward trend in incomes. Hence multicollinearity is a problem. However where both these independent variables are included, both coefficients are generally significantly different from zero. The coefficient for time is consistently negative, implying an autonomous downward trend in butter consumption over time. This finding is also consistent with Wierenga's earlier results. The coefficient for national income per capita is usually positive, as one would expect, and highly significant.

(e) Seasonal variation

The significance of the differences between seasons, as measured by the coefficients of the dummy variables was tested by using the F- test.* Each regression was carried out both with and without the dummy variables. It could then be ascertained whether or not the coefficients of the dummy variables, taken together, were significantly different from zero. In

* See Kmenta, J. (1971) Elements of Econometrics p. 370 New York, Macmillan

almost all cases, the seasonal variation was found to be significant. Generally consumption of butter is greater than average in the last quarter, probably due to Christmas festivities, and lower than average in the previous quarter.

7. Summary and conclusions.

It would appear from our analyses that the price elasticity of demand for all butter is near unity.* For fresh butter the price elasticity is considerably higher at more than 2. The release of cold-store butter on to the market at a price substantially below that for fresh butter causes a substantial drop in consumption of fresh butter. The markets for fresh butter and cold-store butter are clearly interdependent. If in future no more cold-store butter is released on to the market it is likely that the price elasticity of demand for fresh butter will approach our estimate for all butter, namely unity. That being so the level at which the retail price is fixed will have little effect on the total revenue from butter sales.

The price of margarine appears if anything to have a perverse effect on butter consumption, a rise in margarine price being associated with a decline in butter consumption. However we suggest that this could be linked with changes in margarine quality. Such quality changes are likely to have more influence on the butter market in the future, than the pricing policies of margarine manufacturers.

The gradual downward trend in butter consumption may be a cause for concern to the dairy industry. However it may be counteracted in part by increasing incomes and a positive income elasticity of demand for butter.

* Using the common convention of expressing demand elasticities as positive numbers.

Appendix Table 1

TOTAL QUANTITY OF BUTTER DEMANDED IN THE NETHERLANDS. 92 OBSERVATIONS. 4 WEEKLY PERIODS 10.9.66 - 8.9.73

EQUATION	CONSTANT	P _g	P _m	N	R	I	t	C _{b(t-1)}	D ₁	D ₂	D ₃	R ²	R ²	D=W
1	73.31 (7.63)	-.15 (4.12)	-.21 ^{NS} (1.20)				-.18 (5.78)		-.84 (.64)	-3.37 (2.49)	1.05 (.83)	.80	.78	.54
2	26.64 (3.96)	-.16 (7.66)	-.09 ^{NS} (.91)	.0008 (12.76)			-.87 (15.21)		-.95 (1.23)	-3.9 (4.94)	1.22 (1.64)	.93	.93	1.55
3	-50.29 (3.25)	-.12 (4.75)	-.06 ^{NS} (.47)		1.08 (8.92)		-.73 (11.08)		1.15 (1.21)	-4.72 (4.78)	.51 (.56)	.90	.89	1.21
4	100.11 (11.11)	-.19 (2.75)	-.52 (2.75)	-.0001 (2.77)					-.58 (.39)	-2.74 (1.79)	1.48 (1.04)	.74	.72	.38
5	114.04 (16.33)	-.19 (4.91)	-.52 (2.77)		-.18 (2.94)				-.55 (.37)	-2.61 (1.73)	1.57 (1.11)	.75	.73	.38
6	38.13 (3.28)	-.18 (5.02)	.31* (2.38)				-.20 (8.51)		-.80 (.62)	-3.28 (2.48)	1.18 (.96)	.81	.79	.50 * Health margarine
7	21.50 (3.01)	-.16 (7.74)	.006 ^{*NS} (.07)	.0008 (12.21)			-.88 (15.32)		-.94 (1.21)	-3.93 (4.90)	1.27 (1.71)	.93	.92	1.51 * Health margarine
8	18.56 (2.57)	-.16 (7.37)	-.10 ^{NS} (.92)			.01 (12.48)	-.87 (14.88)		-.98 (1.25)	-3.99 (4.94)	1.19 (1.58)	.93	.92	1.53
9	100.91 (11.51)	-.19 (4.7)	-.52 (2.73)			-.002 (2.81)			-.58 (.39)	-2.74 (1.03)	1.48 (1.80)	.74	.72	.38
10	17.01 (2.30)	-.14 (6.09)	-.08 ^{NS} (.81)			.01 (6.87)	-.75 (7.06)	.13 ^{NS} (1.32)	-.74 (.92)	-3.31 (3.34)	1.61 (1.96)	.93	.92	1.77 (91 obs.)
11	31.10 (3.46)	-.09 (3.28)	-.14 ^{NS} (1.07)			-.00006 (.14)		.70 (10.05)	.45 (.45)	.13 (.12)	3.54 (3.64)	.88	.87	2.23 (91 obs.)
12	13.67 (2.80)	-.16 (7.74)				.01 (12.62)	-.88 (15.74)		-.98 (1.25)	-3.99 (4.93)	1.24 (1.65)	.93	.92	1.49

Note: Figures in brackets are t - statistics

NS = not significant at the 5% level

Appendix Table 2

QUANTITY OF FRESH BUTTER DEMANDED IN THE NETHERLANDS. 87 OBSERVATIONS. 4 WEEKLY PERIODS 10.9.66 - 21.4.73

EQUATION	CONSTANT	P_b	P_m	N	R	I	t	C_k	C_b	D_1	D_2	D_3	R^2	\bar{R}^2	D-W	
13	209.03 (6.95)	-1.14 (7.36)	-.08 ^{NS} (.30)				.31 (3.12)			3.28 (1.82)	3.74 (2.08)	5.28 (3.24)	.75	.73	.73	
14	74.05 (1.50)	-.72 (3.73)	.46 ^{NS} (1.60)	.0008 (3.35)			-.62 (2.12)			3.12 (1.84)	3.72 (2.19)	5.48 (3.57)	.78	.76	.42	
15	176.49 (2.78)	-1.09 (6.11)	.01 ^{NS} (.05)		.19 (.58)		.18 ^{NS} (.76)			3.28 (1.82)	3.67 (2.02)	5.25 (3.21)	.75	.73	.38	
16	173.29 (10.94)	-1.06 (10.00)	.05 ^{NS} (.23)	.0003 (4.12)						3.37 (1.95)	3.89 (2.25)	5.36 (3.43)	.77	.75	.41	
17	128.79 (12.99)	-.98 (8.82)	.16 ^{NS} (.74)		.42 (3.08)					3.21 (1.78)	3.50 (1.94)	5.21 (3.20)	.75	.73	.38	
18	76.42 (1.61)	-.71 (3.62)	.33 ^{*NS} (1.63)	.0006 (3.10)			-.43 ^{NS} (1.89)			2.99 (1.76)	3.43 (2.00)	5.18 (3.37)	.78	.76	.40	*Health margarine
19	76.43 (1.48)	-.75 (3.88)	.43 ^{NS} (1.47)			.01 (3.08)	-.56 ^{NS} (1.89)			3.13 (1.83)	3.73 (2.17)	5.47 (3.53)	.78	.76	.41	
20	169.66 (11.03)	-1.06 (9.86)	.06 ^{NS} (.26)			.004 (4.03)				3.36 (1.94)	3.89 (2.23)	5.36 (3.41)	.77	.75	.40	
21	51.65 (1.63)	-.35 (2.84)	.09 ^{NS} (.48)			.0009 ^{NS} (.38)	.05 ^{NS} (.29)	.75 (11.50)		1.63 (1.54)	2.25 (2.08)	1.47 (1.46)	.91	.91	1.78	(86 obs.)
22	43.56 (3.05)	-.33 (3.60)	.12 ^{NS} (.94)			.002 (2.10)		.75 (12.01)		1.62 (1.55)	2.26 (2.10)	1.51 (1.52)	.91	.91	1.77	(86 obs.)
23	49.19 (3.88)	-.33 (3.59)				.002 (2.54)		.75 (11.99)		1.65 (1.58)	2.24 (2.08)	1.50 (1.51)	.91	.91	1.74	(86 obs.)
24	175.47 (13.80)	-.80 (9.70)	-.57 (2.98)			.003 (3.86)		-.66 (11.45)		.22 (.17)	-2.79 (1.74)	1.26 (1.09)	.95	.94	1.22	(47 obs; Cold-store butter available)
25	19.17 (1.05)	-.26 (2.80)				.014 (8.55)	-.99 (7.64)	-.62 (16.11)		.11 (.13)	-1.93 (1.70)	2.69 (3.20)	.98	.97	1.76	(47 obs; Cold-store butter available)
26	160.04 (26.09)	-.68 (13.97)	-.51 (5.50)			.002 (4.87)				.55 (.64)	-1.78 (2.06)	1.61 (1.90)	.98	.98	2.31	(38 obs; Cold-store butter not available)
27	184.92 (15.66)	-.75 (11.01)	-.61 (5.99)				.16 (4.31)			.69 (.75)	-1.65 (1.82)	1.74 (1.96)	.98	.97	2.22	(38 obs; Cold-store butter not available)
28	60.69 (3.31)	-.42 (4.78)				.009 (5.80)	-.58 (4.76)			.19 (.20)	-1.93 (2.06)	1.40 (1.52)	.98	.97	1.82	(38 obs; Cold-store butter not available)

Note: Figures in brackets are t - statistics
NS - not significant at the 5% level

