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Food consumption and economic development in the European Union

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Summary

This paper investigates the relationship between food consumption and economic development in 16 European countries. Differences in food diets are analysed using data on per capita calorie intake. Results provide a better knowledge of the dynamic evolution of consumption patterns in European countries, the existence of convergence towards a common diet and the adequacy of implementing common food policies in these countries.

Keywords: food diet; European Union; convergence.

1. Introduction

This paper analyses trends in food consumption patterns in Western Europe over the last two decades. The countries included are the fifteen members of the enlarged European Union plus Norway. The analysis uses data compiled by the Food and Agriculture Organisation of the United Nations (FAO) and the International Monetary Fund (IMF) on aggregate food consumption, its product composition expressed in calories per capita per day, and real per capita income in U.S. dollars (at 1985 domestic prices and exchange rates). Data refer to the quantíty of food available for human consumption allowing for waste in storage and processing. Although data may not be treated as precise estimates of consumption, they provide a useful approximation to changes that have taken place over time. However, food balance sheet reliability depends on the accuracy of national data, methods of data collection and data availability (Henson and Loader, 1991). The definition of edible food, movements of food via tourism, wastage and levéis of food production are problems which arise when making compari-

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sons between countries. These problems are not randomly distributed between countries and must be borne in mind when using food balance sheet data.

The use of caloric equivalents has both advantages and limitations. It facilitates aggregation of different foods and the derivation of shares by types of foodstuff. Caloric equivalents are assumed to be constant over time and to be common across countries, which simplifies cross-country compari-sons of changes in consumption. When using monetary measures, differences in price levéis between countries must be taken into account, which makes the study more complex. However, the use of a common set of caloric conversión factors for all countries and years to convert from product weights to caloric equivalents, is the main limitation. This approach ignores that these conversión factors may differ through time and across countries.

The study of trends in food consumption patterns is not new. In Blandford (1984), for OECD countries, and Wheelock and Frank (1989), for nine developed countries, a convergence of dietary patterns in European countries is suggested. Henson and Loader (1991) use the same data that are used in this paper and suggest that there are patterns in food consumption although these patterns are not entirely geographical. Grigg (1993) relates the convergence in food patterns to economic development and to concerns about health. Connor (1994) and Uhl (1991) compare food consumption patterns in the USA and Western Europe. Both show a convergence and Connor (1994) establishes that European per capita food consumption growth has been correlated with prior, but not contemporaneous, growth in the USA, so trends in the USA are good predictors of changes in Western Europe, particularly at more aggregate levéis. In all these papers, there is no attempt to measure how this convergence process has taken place and if it only affects total calorie intake or extends to specific producís. Herrmann and Róder (1995) provide a methodology to measure cross-country differences in food consumption and reach similar results to those obtained in this paper.

The objective of this paper is to analyse the evolution of food diets in some European countries and to see if it is possible to identify a common European diet. To achieve this objective, the paper is organised as follows. First, trends in total food consumption and in the consumption of animal versus vegetable producís are outlined. Next, the evolution of diet composi-tion is evaluated over the 1970 to 1990 period using a dynamic factor analysis. Finally, some measures of convergence are deemed in order to determine if European countries are achieving a common consumption pattern.

2. Trends in total food consumption in EU countries

Table 1 shows the evolution of the apparent per capita daily food consumption for EU countries. The apparent average food consumption in EU

countries was 3,211 calories/capita/day in 1970, and increased at an average rate of 0.4 per cent per year to reach 3,452 calories/capita/day in 1990. Consumption in most countries has shown an upward trend except for the Netherlands and Sweden, where it has remained constant, and the United Kingdom and Finland where it has declined slightly. Spain, the country with the lowest apparent per capita consumption in 1970 has shown the largest increase, about 25 per cent between 1970 and 1990.

Economic theory suggests that the main determinants of changes in food consumption are variations in real consumer income and in the price of complementary or substitute goods. In the case of food, few other goods can be considered cióse substitutes. Thus, it is likely that the principal economic determinant of long-run changes in per capita food consumption is variation in real consumer income. Generally, a positive correlation between income and consumption is observed, so that countries with higher income levéis have higher consumption levéis. However, a mínimum level of food consumption must be attained. Therefore, with low income levéis, food consumption is relatively high and, as income grows, food consumption increases at a lower rate, up to a threshold which is difficult to surpass because of physical limitations (population is growing relatively slowly in EU countries), although it generally becomes more diversified.

The proportion of calories derived from animal products is lower than the proportion derived from vegetable products in each country (Table 1), although there have been significant changes in many countries in recent years. In 1970, and especially in Mediterranean countries (Greece, Spain, Italy and Portugal), differences were more significant and, on average, animal products provided just 19 per cent of total food calorie intake. In the other countries, over 30 per cent of total calories were derived from animal products.

Over time, two major trends in food calorie consumption can be observed. All countries, with the exception of Germany, showed an upward trend in the share of animal calories consumed over the period 1970 to 1980. However, in the decade from 1980 to 1990, the share of animal calories has stabilised or even declined. In 1990, on average, EU countries derived 34 per cent of their total consumed calories from animal products.

Income is likely to be a major determinant of long-run changes in the proportion of food derived from animal sources. It is also possible that changes in the price of animal products relative to vegetable products may have had an impact. The growth of industrialised livestock production in Europe and the decline in the relative price of many animal products have reinforced the trend towards increased consumption of these products with growth in incomes (Blandford, 1984). However, no price data are available and so the analysis has been restricted to the relationship between total food consumption and per capita income, and between animal calories and per capita income.

Table 1. *Evolution of average food consumption and per capita GDP in EU countries* (daily calories and dollars)

	1970			1980			1990		
	Total capita calories	Animal calories (%)	Per capita GDP	Total calories	Animal calories (%)	Per capita GDP	Total calories	Animal calories (%)	Per
Austria	3292	33.5	5717	4323	36.5	8087	3459	34.9	9848
Belgium-Lux.	3358	35.7	5981	3529	39.3	8003	3922	39.7	9582
Denmark	3402	41.5	8271	3505	44.8	9942	3647	45.6	12186
Finland	3128	40.1	7230	3107	43.2	9854	3026	39.5	12842
France	3330	35.7	6902	3431	39.6	9003	3618	38.5	10696
Germany	3197	35.7	7448	3303	34.8	9621	3465	35.9	11550
Greece	3204	19.4	2099	3347	24.5	3032	3779	24.7	3354
Ireland	3693	40.6	3639	3905	42.6	4915	3987	36.9	6844
Italy	4321	18.8	5032	3588	23.4	7018	3483	25.6	8543
Netherlands	3043	31.7	6901	3097	33.6	8474	3024	32.5	9622
Norway	3047	37.2	10774	3387	38.7	12065	3219	36.7	14809
Portugal	2991	16.5	1360	2929	19.5	2027	3420	24.3	2631
Spain	2822	22.7	3174	3268	28.8	4118	3494	32.3	5296
Sweden	2927	33.5	9418	3036	37.0	11062	2962	36.1	12974
United Kingdom	3316	38.9	6186	3146	37.0	7425	3281	33.4	9297

Source: FAO (1993) and IMF (several years).

3. Methodology

Taking into account the possibility that the evolution in consumption of both total and animal producís might reach a máximum as income grows, statistical estimates were derived using regression analysis assuming a recip-rocal functional form:

$$C_t = \alpha_0 + \alpha_1(1/GDP_t) + e_t$$

$$AC_t = \beta_0 + \beta_0(I/GDP_t) + e_t$$

where
C_t = per capita consumption (calories/capita/day)
AC_t =per capita animal product consumption (calories/capita/day)
GDP_t =real per capita GDP in US dollars, at 1985 domestic prices and exchange rates
α_0 β_0 =upper asymptotes (máximum potential consumption levéis)
α_0 β_0 =parameters attached to income
e_t =disturbance term.

Functions (1) and (2) were estimated by ordinary least squares (OLS), and by generalised least squares (GLS) when serial correlation was present. Annual data from 1961 to 1990 were used. Table 2 presents estimated income elasticities, for years 1970, 1980 and 1990, and the máximum potential levéis of food and animal product consumption derived from these regression equations. Due to the specific properties of the reciprocal functional form, income elasticities decrease in all countries for both total and animal producís consumption over the period considered.

In Table 2, the absence of any valué indicates that, for that country, no significant relationship (at the 5 per cent level of significance) was found between income and total food consumption or between income and animal product consumption. Higher valúes are presented in countries with lower consumption levéis in the first years, like Spain, Greece and Italy, or where apparent per capita food consumption has substantially increased in recent years (i.e. Belgium).

Two main features of the elasticities are noteworthy. First, the income elasticities for animal producís are always higher than those for total food consumption. Second, higher income elasticities are found in countries with a higher máximum potential level of consumption.

4. Evolution of dietary structure in EU countries

The STATIS method (Lavit, 1988) has been used to analyse the dynamic evolution of diet structure in EU countries. Three years (1970, 1980 and

Table 2. *Estimated income elasticities and máximum potential level of consumption for apparent per capital total food and animal products consumption*

	Per Capita Food Consumption				Per Capita Animal Products Consumption			
	Máximum potential level[1-2-3]	Income elasticities[2]			Máximum potential level[1-2]	Income elasticities[2]		
		1970	1980	1990		1970	1980	1990
Austria	3720(24.21)	0.14	0.09	0.08				
Belgium-Lux.	4688(10.64)	0.45	0.32	0.24	2083(16.54)	0.7	0.49	0.3
Denmark	3950 (21.42)	0.18	0.14	0.11	1913(10.01)	0.3 5	0.26	0.2 0
Finland		0.15	0.11	0.09		0.3 7	0.25	0.2 0
France	3845(10.83)				1645 (31.57)			
Germany	3922 (43.9)	0.23	0.18	0.14	1450 (26.63)	0.2 9	0.22	0.1 8
Greece	4252 (26.72)	0.30	0.20	0.16				
Ireland	4285 (71.72)	0.16	0.11	0.08		0.9 1	0.49	0.3 8
Italy	4309(13.18)				1239 (21.56)			
Netherlands				0.09	1091 (22.7)	0.1	0.07	0.0
Norway	3531 (19.42)		0.11		1308 (9.73)	0.1	0.11	0.1
Portugal		0.36	0.25	0.21				
Spain	4269(16.39)	0.14						
Sweden	3206 (33.28)				1365(11. 35)	0.37	0.27	
United Kingdom	3928(14.18)	0.49	0.33	0.2				
		0.09	0.07	0.0				
		0.25	0.25	0.1				0.25

[1]Calones per day.
[2]All coemcients were significant at the 5% level.
[3]t-ratios are in parentheses.

1990) and fifteen countries have been considered. The following product groups have been incorporated into the analysis: (1) cereals; (2) potatoes; (3) meat; (4) fish; (5) vegetable oils; (6) animal fats; (7) milk, dairy products and eggs; (8) vegetables and pulses; (9) fruits; and (10) sugar. This method involves three stages: (a) the global evolution of variables during the sample period is studied and a compromise, or intermediate matrix, is defined; (b) a factor analysis is carried out on the intermediate matrix; and (c) the average relative position of each country and its movements through the period considered are defined.

Results of factor analysis on the intermediate matrix show that the first three factors explain more than 76.5 per cent of matrix inertia. Correlations between variables and the main factors are shown in Table 3. The first factor explains 46.1 per cent of variance. It is positively correlated with the share of average calorie intake from meat, animal fats, milk and dairy products and sugar, and negatively correlated with vegetable oils, fruits and vegetables. Most of the positive correlation diminishes over the period considered whilst the negative correlation remains significant. This factor separates countries with a high consumption of animal products from countries with a high consumption of vegetable products. The second factor explains 15.4 per cent of variance. It is positively correlated with fish consumption and negatively with the relative importance of meat consumption. The third factor explains 14.9 per cent of variance and is positively correlated with the share of calorie intake coming from fruits and negatively correlated with potatoes.

The evolution of diet structure in EU countries over the period 1970 to 1990 is analysed looking at the path followed by each country with respect to its average over the period. Results are shown in Figure 1. The horizontal and vertical axes correspond to factors 1 and 2 from the factor analysis. The number following each country's initials indicates the year (1 = 1970; 2=1980; 3 = 1990). An asterisk cióse to each country indicates its average position over the period considered. In general, there have not been large movements along the horizontal axis, which indicates that the proportion of total calories from animal fats, milk and dairy products, sugar, vegetables and fruits has only changed slightly over the period 1970 to 1990.

However, there has been some movement along the vertical axis, indicating that the proportion of calories from meat and fish has changed. Denmark and Spain are interesting cases, as meat products represent an increasing proportion of total calories. Norway has an upward trend, indicating the growing relative importance of calories from fish.

Mediterranean countries have a diet structure which differs from other EU countries. However, slight movements to the right have been observed, while in the rest of the EU, if any horizontal movement has occurred, it is towards the left, indicating convergence in the structure of diet within the European Union.

Finally, the degree of similarity in the evolution of the structure of calorie

Table 3. *Correlations between variables and main factors from factor analysis made on the intermedíate matrix from the STATIS method*

	Cereals	Potatoes	Meat	Fish	Veg. Oils	Animal Fats	Milk, Dairy and Eggs	Veg. + Pulses	Fruits	Sugar
Factor 1										
1970	0.90	0.31	0.63	-0.07	-0.73	0.87	0.70	0.92	-0.71	0.92
1980	0.83	0.14	0.55	0.13	-0.90	0.88	0.61	0.93	-0.48	0.75
1980	0.58	0.30	0.32	0.06	-0.89	0.71	0.63	0.89	-0.55	0.66
1990	0.00	0.02	-0.61	0.66	0.30			0.18	-0.01	0.26
	0.11	-0.03	-0.73	0.74	0.19	-0.18	0.55			
Factor 2	0.23	0.22	-0.69	0.64	0.10	-0.23	0.57	0.17	0.08	0.35
1970						-0.37	0.54	0.21	0.24	0.40
1980	0.04	-0.76	-0.18	-0.55	**0.17**			0.26	0.61	-0.00
1980	0.12	-0.75	-0.24	-0.38	0.06	0.19	0.15			
1990	0.15	**-0.64**	-0.33	-0.48	0.01	0.29	0.12	0.21	0.68	0.24
Factor 3						0.40	0.17	0.28	0.65	0.35
1970										
1980										
1980										
1990										

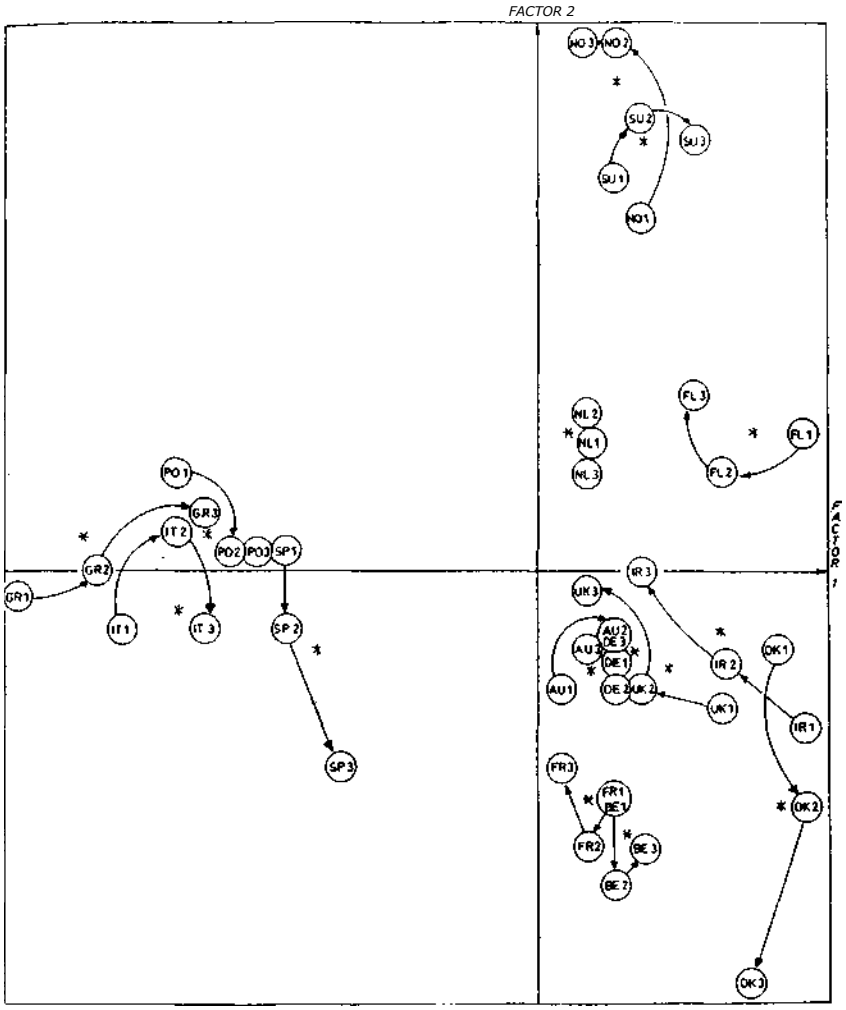

Figure 1, *Evolution of diet structure in the EU countries*[1 t13]

[1] A number following each country's initials indicates the year (1 = 1970; 2 = 1980; and 3 = 1990).

[2] An asterisk indicates the average position of each country over the period considered.

[3] Horizontal and vertical axes are factor 1 and 2, respectively derived from the factor analysis.

intake across countries is explored using cluster analysis. This was used to derive aggregates of countries on the basis of the overall similarity of consumption across the entire set of producís over the period considered. In this case, we have grouped countries that show the same inertia in relation to their diet structure. Figure 2 shows the grouping derived through clustering.

Group 1 includes Austria (AU), Germany (DE) and the Netherlands

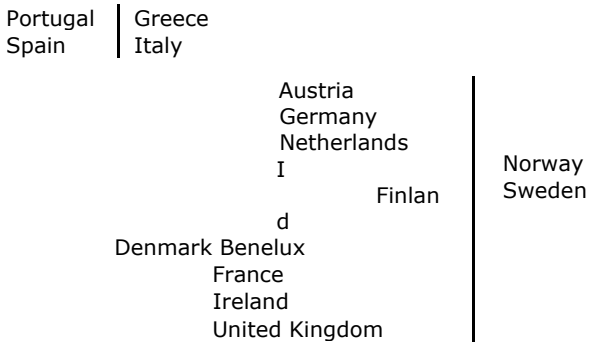

Figure 2. *Grouping of EU countries based on dietary structure in 1970, 1980 and 1990*

(NL). The behaviour of this group is similar to Group 2: Belgium-Luxembourg (BE); France (FR), Ireland (IR) and the United Kingdom (UK). These two groups obtain a higher proportion than average of their calories from animal fats, milk and dairy products and sugar. In Group 2, the proportion of calories from meat is higher than in Group 1. The evolution of diet structure in Denmark (Group 3) is similar to Group 2, although the proportion of calories from meat products is the highest in the EU. Norway and Sweden form Group 4. In these countries, the proportion of calories from meat is the lowest in the EU. Group 5 contains only Finland. This country has a similar diet structure to Group 4 although a substantially larger proportion of its calories comes from meat. Mediterranean countries have been divided into two groups: Greece and Italy (Group 6) and Portugal and Spain (Group 7). Countries in Group 6 differ from those in Group 7 in that a substantially higher proportion of total calories are obtained from cereals and a slightly lower proportion from fish. Results from this analysis differ slightly from those found by Henson and Loader (1991) using cluster analysis, although a different set of countries is considered. The main differ-ence is that, in their study, France was located amongst the Mediterranean countries while here its evolution is closest to the northern countries.

5. Towards a common European diet?

Various popular versions of the neoclassical growth model imply that per capita incomes eventually converge to a common equilibrium valué if the rates of time preference and production functions are the same across regions or countries. Barro and Sala i Martin (1991, 1992) note two different measures of convergence which they cali sigma- and beta-convergence.

In this section, we apply these two concepts to explore whether there is a trend towards a common European diet. Data used cover total calorie intake and the proportion of total calories from animal products, cereals, potatoes, pulses, vegetables, fruits, meat, sugar, milk, vegetable oils, animal fats, eggs and fish.

Sigma-convergence is defined as a reduction in the cross-section standard deviation over time (in our case from 1970 to 1990). Sigma-convergence gives a rough presentation of the evolution of the distribution of total calories across countries, even though it is time dependent.

Beta-convergence occurs when consumption in the lower calorie-intake countries grows faster than that of the higher calorie-intake countries. A similar interpretation can be given to both measures when considering the proportions of total calories from different food products. The presence of beta-convergence is a necessary condition for sigma-convergence, but it is not a sufficient condition. A formal examination of the relation between these concepts can be found in Barro and Sala i Martin (1992).

Beta-convergence has been estimated using the regression:

$$(1/T)\log (y_{i,to+T} / y_{i,to}) = a - (1-e^{-\beta T} / T)\log(y_{i,to})+ui_{,to,to+T}$$

where

$y_{i,to}$ = total per capita calorie intake in country *i* in year t_0

$y_{i,to+T}$ = total per capita calorie intake in country *i* in year

T = period length

β = speed of convergence

$^{U}i,t_0,t_0 + T$ =distributed lag of the error terms, u_{it}, between years t_0 and t_0+*T.*

Cross-section regressions were performed on data for the 15 countries and for periods 1970 to 1980, 1980 to 1990 and 1970 to 1990. Similar regressions were estimated substituting total calories for the proportion of total calories from the food products detailed before. All regressions were estimated using nonlinear least squares.

If beta-convergence exists, (1 — e ^^{T}) must be positive, and this requires *fi* > 0. Table 4 shows results on beta-convergence obtained by estimating equation (3) across countries over the period 1970 to 1990. All the /?-coefficients are positive, indicating that consumption in countries with lower calorie intakes in 1970 has increased more quickly than in countries that began the period with higher intakes. The same occurs when analysing the proportion of total calories from different food products. However, the relationship is not significant (at the 10 per cent level) for total calories, potatoes, vegetable oils and fish. In general terms, the results from this analysis suggest there has been convergence in diet structure across European Union countries.

Although the convergence process is long-run, it is interesting to split the

Table 4. *Convergence in diet structure in EU countries (1970 to 1990)*

	1970 1990 -			
	a	**P**	R^2	BP
Total calories	0.068 (0.64)	0.0088 (0.55)	0.027	3.93
Animal producís calories	-0.022 -5.5)	0.03 (4.84)	0.78	1.2
Cereals	-0.033 -3.73)	0.027 (2.44)	0.45	0.03
Potatoes	- 0.042	0.013 (1.46)	0.18	0.94
Pulses	-0.14 -5.84)	0.0457 (3.51)	0.72	2.84
Meat	-0.037 -1.9)	0.031 (1.78)	0.32	0.02
Vegetable oils	-0.027 -1.36)	0.017 (1.42)	0.18	2.39
Animáis fats	-0.047 -3.19)	0.016 (2.4)	0.39	1.4
Milk	-0.024 -3.01)	0.0125 (2.85)	0.45	0.65
Eggs	-0.056 -2.19)	0.014 (1.79)	0.25	0.025
Sugar	-0.052 -4.04)	0.029 (2.59)	0.5	2.34
Vegetables	-0.079 -6.17)	0.028 (5.15)	0.79	1.3
Fruits	-0.04 -1.66)	0.015 (1.56)	0.2	2.3
Fish	-0.023 -0.89)	0.007 (1.08)	0.09	0.18

[1] Valúes in parentheses are t-statistics.
[2] BP is the Breusch-Pagan test for heteroscedasticity. Critical valué at the 5% level of significance
is 3.84.

period into two sub-periods (1970 to 1980 and 1980 to 1990) to see whether this process has been homogeneous during the whole period considered. Results from both sub-periods (not reproduced here) show that in both sub-periods, all /?-coefficients are positive, indicating convergence. However, in the period 1980 to 1990, a higher proportion of /?-coefficients are not significant (most notably, for meat, vegetable oils, eggs, sugar and fish, which are significant in the earlier sub-period), indicating that the process of convergence, to a large extent, took place during the 1970s and has been less intensive during the 1980s. By contrast, however, the /?-coefficients for milk and potatoes were insignificant for the 1970 to 1980 period, but significant for the following decade.

The second concept analysed is the sigma-convergence, defined as the reduction of total caloñe intake standard deviation over the 1970 to 1990 period. The evolution of the standard deviation for the proportion of total calories from food producís is also analysed. Figure 3 shows the main results. The standard deviation of total calories intake increased over the whole period. It decreased at the beginning of the seventies but showed an upward trend later on.

There is a substantial reduction in the standard deviation of the proportion of total calories from animal producís and cereals. For fish, however, the opposite situation occurs. In general, results from Figure 3 are consistent with those from Table 4. There is convergence in diet structure across European countries but the speed of convergence has been lower in more recent years.

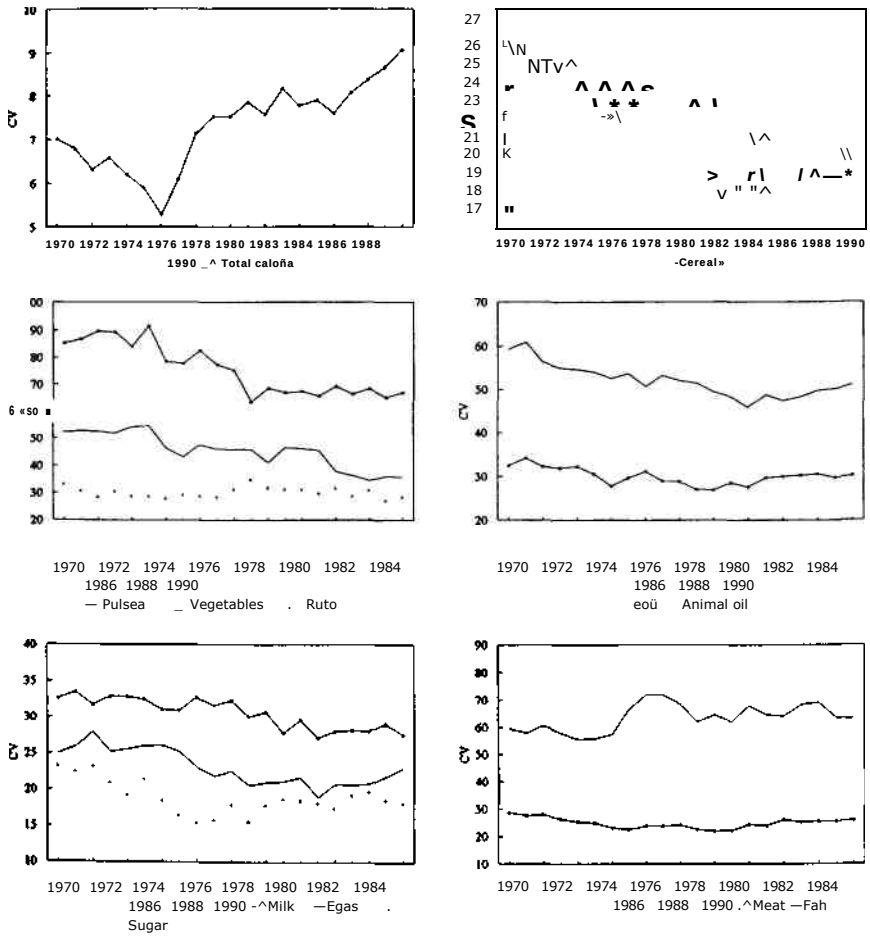

Figure 3. *Sigma-convergence of the diet structure across EU (1970 to 1990)*

6. Conclusions

The results presented above seem to indícate a trend towards a common European diet. Several facts reinforce this idea. Per capita food consumption in the European Union countries appears to have reached a ceiling, although national differences still exist. Furthermore, in some countries, total calorie consumption has declined in recent years. This result indicates that further growth in per capita income will genérate a smaller increase in total food consumption. Since the rate of population growth is relatively low in these countries, no further increase in food consumption is expected. The proportion of calories derived from animal producís has stabilised in recent years and its responsiveness to income growth has declined.

Dietary structures in EU countries are becoming increasingly similar, although some differences have been found in the evolution of the dietary structure of the Mediterranean countries compared to other countries. Two measures of convergence have been used to test whether these similarities are sustainable. Results indicate that there is no strong evidence of convergence in total calorie intake. However, when considering the proportion of total calories derived from the main food groups, convergence can be observed in most producís, indicating increasing similarity in European countries diets. However, the speed of convergence has decreased in the last decade.

This convergence is the result of several forces. First, the largely parallel trends in the determinants of food demand in European countries: the orthodox economic factors of household income, relative prices (as markets become more integrated), demographic changes and the newer concerns by consumers about the nutritional impacts and preventative health possibilities of dietary habits (Connor, 1994). Second, the increased vertical and horizontal integration in European firms: technological transfers, multinational marketing strategies (European brands, promotion, etc.) and the internatio-nalisation of food distribution. Third, the evolving similarities in public policies.

The shift of diet in Mediterranean countries towards a continental diet structure is expected to continué, together with increased consumption of fruit, vegetables and vegetable oils in Northern countries. Total food consumption and the share from different food groups will not vary substantially in the future. Despite this, there is still some consumption variation between EU countries. It is difficult to identify a 'Euroconsumer', but the same difficulties arise when one attempts to define, say, a Spanish or a British consumer. In aggregate terms, as has been done in this article, convergence exists, but it is also likely that there are market segments with homogeneous socio-economic characteristics that cut across national boundaries within the EU. Marketers and policy makers should be aware of these segments to try to identify and satisfy them. From this point of view, further research

is needed at different levéis of aggregation although a lack of sufficient homogeneous information across Europe will make this difficult.

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