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**REGIONAL DIFFERENTIALS IN PRODUCTIVITY AND TYPES OF FARMING IN
FRANCE: 1980, 1985**

von

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Until the fifties French agriculture had been essentially static. As compared with other countries, it was underdeveloped and considered as an industry closely embedded in its environment. Since the mid-fifties France has experienced a dramatic transition, both output and productivity growth have accelerated after a long period of relative equilibrium. Since 1959 France has achieved a 2.2 percent annual rate of growth in output and a 2.6 percent annual rate of growth in total factor productivity (GUYOMARD, 1988, p. 57 and p. 79).

During the last decades, it has experienced the same path of development as comparable countries achieved before (RUTTAN et al., 1978, pp. 44-87). The driving force of production expansion has been factor substitution which resulted in a trend towards more intensive farming.

This process of development has led to more specialized farms concerned with either crops or animal production. The growth of poultry and pig enterprises is often quoted as an example of this path of evolution. However the major feature is the tremendous growth of the crop sector: cereals since the implementation of the CAP and oilseeds during the last decade. The average rates of growth vary markedly between commodities and therefore the output composition has changed: the share of cereals in total output (in volume) has increased from 9 % to 18 % during the last three decades.

The geographical spread of cereals has induced the emergence of new specialized regions in which other commodities have declined by large. This has been possible because the natural conditions through drainage and plot consolidation have been modified. So the other aspect of the growth process is an increasing regional specialization which in turn has involved a higher regional concentration for each commodity. In the early sixties highest levels of concentrations were achieved by cereals and vineyards, for which natural conditions are not completely man made. But the path towards higher regional concentration has been fastest for animal production. Now, except for wine, pig and poultry production are the most concentrated commodities. Dairy production is as concentrated as cereals and fruit production.

The geographical distribution of commodities has simplified so it has become possible to identify a small number of regional types of farming. It is the first issue we address in this contribution. The second point is concerned with spatial differences of productivity. We will consider them in combination with types of farming.

1 Regional types of farming

This section is based on the results of principal component, correspondence and clustering analyses. Their common objective was to establish regional typologies of French agriculture over the last three decades. We will emphasize their outcome for the most recent period, 1980-1985, for which needed data were available. Otherwise we will mainly present results restricted to a division of France into 22 regions. They correspond to level 2 of Eurostat nomenclature of statistical territorial units. But similar results are also available for a breaking-down into 90 units which are the départements, and is consistent with level 3 of the nomenclature. (BONNIEUX, 1986; BONNIEUX, FOUET and RAINELLI, 1987).

The data input includes agricultural outputs and materials. Different levels of aggregation of these variables were considered and up to 20 categories have been introduced in computer runs. Moreover extra variables were also taken into account in various tests. They concern the primary inputs and the distribution of holdings by size. The latter is useful since it gives some information regarding heterogeneity within regions. However our own experience, but it is only an empirical finding, demonstrates that several variables are redundant. If the purpose is restricted to the determination of a regional typology, the composition of production appears to be the most interesting information.

Both principal component and correspondence analyses lead to a dimension reduction. Regarding our objective we have given much greater attention to dimension reduction on the regions. A two-dimensional representation using either the first two principal components or the first two factors of correspondence analysis is fruitful since three clusters are visually evident. Data speak very freely and the symmetry between object space and variable space allows identifying three basic types of farming:

- field crops: cereals, roots,
- permanent crops: vineyards, fruit crops,
- animal production.

Data processing based on a stepwise clustering methodology leads to a similar outcome. The latter runs use a hierarchical algorithm in which similarity between regions' profiles is measured by a weighted squared distance. Categories remain valid whatever geographical division and years considered. Therefore we have obtained a firm conclusion but also a very naive one.

In order to go further it is necessary to break down basic types of farming. The linkage tree generated by the clustering process suggests the existence of subdivisions. Graphic representations using higher levels than level two, principal components or factors allow a better definition of clusters. As a matter of fact it is enough to consider up to the fourth component or factor since at this stage about 90 % of total variance of the data set are taken into account.

The carrying out of a regional typology is easier for the most recent years than it was for the beginning of the period. In 1960, in the Paris Bassin traditional mixed farming gave way to arable farming systems and the Mediterranean agricultural sector achieved its evolution towards highly specialized permanent crop farming. But in animal production areas the specialization process only started during the late fifties. At the regional level the emergence of intensive livestock farming with pigs or poultry has been significant in Brittany from the mid-sixties. Therefore the animal production category gathered overlapping clusters at the time. For instance to identify cattle farming and dairy farming it would have been necessary to consider very small areas and maybe the farm level. This division has occurred gradually and is actually meaningful at a regional level.

The map (Graph 1) is the output of 1985's data processing. It is simple but we think it gives a relevant view of French agriculture for the eighties. There are five basic categories but with the subdivisions and combinations of criteria many occurrences are theoretically feasible. However such a classification is relevant if there is enough homogeneity within regions. The same computations run with 90 territorial units provide arguments which justify this implicit hypothesis. Obviously some départements are not classified in the same category as the region to which they belong, but their share in regional output is so small that it can be considered as being negligible at this stage of analysis. Nevertheless up to the mid-seventies the twenty-two region division is not relevant since heterogeneity within regions was important.

Table 1 shows regional coefficients of specialization. Each of them is a ratio of percentages: the numerator is the given commodity's percentage share of regional output and the denominator is the similar percentage calculated at the nation level.

Coefficients are reported for eight major commodities whose share is about 85 % of total output. Commodities as sheep or quality wine are not considered in table 1 since they are not preponderant at regional level. They do not really influence regional profiles, therefore they are not required to identify the various regional clusters. But let's point out it is not true for a more disaggregated geographical division. For instance départements' profiles depend upon quality wine production which has to be taken into account in order to characterize some farming systems prevailing at this level. Thus the concept of regional types of farming turns out to be contingent and yet instrumental as we will see afterwards.

All the coefficients higher than unity are reported in table 1. A simple inspection shows that in most cases, it is enough to consider one or two commodities to portray the agricultural sector at regional level. However some classifications are questionable considering only these figures. It is not apparent for example that Haute-Normandie belongs to the arable farming category and thus is close to Centre or Picardie. The typology is based on all the information provided by the data set so it would be misleading to consider only the partial information conveyed by table 1. Computation of distances and similarity indexes between profiles is based on more than eight variables. For instance the division of the grazing livestock cluster into two categories requires to

Graph 1: Regional types of farming for the eighties

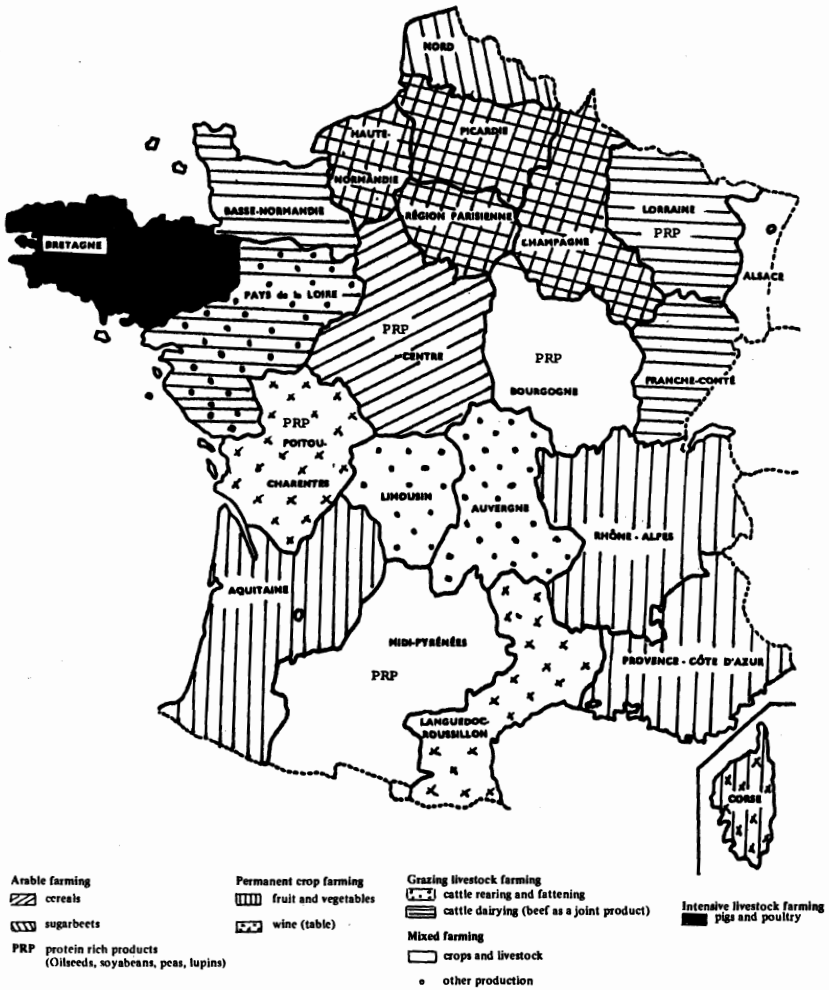


Table 1: Regional coefficients of specialization (1984 and 1985)
 1980 - first; 1985 - second row

	cereals	sugar	PRP	fruits	wine	beef	pigs	milk
	beets			vegetables	table		poultry	
Ile-de-France	2.4	3.6	1.4	1.3				
	2.6	2.6	1.3	1.4				
Champagne-Ardennes	1.8	4.0	1.5					
	1.9	2.8	1.9					
Picardie	1.8	6.7						
	2.0	5.6						
Haute-Normandie	1.4	1.6	1.4			1.3		1.4
	1.5	1.4	0.9			1.4		1.3
Centre	2.7		3.2					
	2.5		2.5					
Basse-Normandie						1.8		2.4
						1.8		2.5
Bourgogne	1.5		2.8			1.6		
	1.4		1.7			1.6		
Nord-Pas-de-Calais		3.1				1.2	1.3	1.1
		2.6				0.8	1.1	1.2
Lorraine			1.9			1.4		1.8
			1.6			1.2		1.9
Alsace								
Franche-Comté						1.6		2.6
						1.5		2.9
Pays-de-la-Loire						1.7	1.2	1.5
						1.7	1.3	1.5
Bretagne						1.3	3.8	2.2
						1.0	3.2	1.7
Poitou-Charentes	1.3		2.1		3.3			
	1.2		2.9		3.7			
Aquitaine				1.5				
				1.3				
Midi-Pyrénées	1.1		2.1			1.1	1.2	
	1.0		2.4			1.1	1.0	
Limousin						3.0		
						3.2		
Rhône-Alpes				1.5			1.1	1.1
				1.3			1.2	1.2
Auvergne						2.0		1.4
						2.2		1.6
Languedoc-Roussillon				2.2	11.6			
				2.1	12.1			
Provence-Côte d'Azur				4.1	2.5			
				4.2	2.2			
Corse				2.1	11.3			
				3.2	7.1			

take into account other variables among them available land per worker is very discriminant.

Interference in the pricing mechanism is the main instrument of the CAP. Price measures create a wedge between the price received by farmer and that prevailing in international trade. The trade distortion they involve have recently received considerable attention (OECD, 1978). They also involve distortions in regional competition since they support some commodities more than others. In order to assess this aspect regional nominal protection rates have been calculated (BONNIEUX, MAHÉ and RAINELLI, 1979).

Arable farming mainly concerns the North-Eastern part of the country where the ratio of land per worker is the highest. However modern technology has made it possible to compensate deficiencies in natural conditions. Such improvements in combination with a high price support have favoured the diffusion of arable farming in the borders of this large area.

The natural conditions still have a strong impact on the location of permanent crops. So permanent crop farming is mainly confined in the Mediterranean area and along watersheds in the South-Western and the South-Eastern parts of the country. Price support is the lowest in these regions.

Regions which are highly specialized in dairy production are located in the East (Franche-Comté) and the West (Basse-Normandie). They enjoy a high level of protection whereas the intensive livestock farming region (Brittany) receives a support close to the national average.

2 Regional differentials in Productivity

In this section we apply the methodology developed by DENNY and FUSS (1980) to analyze sources of intertemporal and interspatial differences in productivity. We only consider cross-sectional data so the time dimension is not taken into account. Differences in output levels are attributed to differences in input levels and regional effects.

Previous work (BONNIEUX, 1986) have shown that the translog specification provides a reasonable approximation of the French agricultural technology. Therefore total output Y_n of region n is related to input levels X_{in} plus a regional technological index T_n :

Constant returns to scale hypothesis is maintained therefore the following conditions hold:

Regional differentials in productivity arise from differences in the production functions in each region: some parameters are common to all regions, others being specific. This

specification assumes that the differences only concern the constant term and the Cobb-Douglas component, the quadratic component is the same for all the regions.

There are too many independent parameters to identify this function. But if we consider it as the underlying production function it is straightforward to derive an index number formula allowing to perform regional comparison of total factor productivity. Assuming competitive markets and denoting by 0 the reference region, total factor productivity of region n is given by P_{no} such as:

where M_{in} and M_{i0} are cost shares in regions n and o. In order to meet transitivity requirements for multilateral comparisons, the reference is defined by the geometric mean of regions.

This formula can be rearranged in order to make evident that the total factor productivity index is a weighted geometrical mean of partial factor productivity indexes. It is nothing more than the adaptation to the spatial context of the Tornqvist's approximation of Divisia's index often used for time series data. Modern theory of index number is now usually presented in both dimensions.

Major difficulties in implementing total factor productivity measurement are concerned with some lack of homogeneous and consistent data for regional capital since time series are not yet available. An important statistical work is still in progress but not completed. Therefore the following results are based on provisional figures for buildings and machinery which are nevertheless consistent with national accounts series.

For the calculation of indexes reported in this paper we have considered one output and four inputs: materials, capital, land and labour. Otherwise exploratory calculations were made with a higher level of disaggregation but their results are not discussed here.

Regional indexes are given in table 2 for 1980 and 1985. Figures are consistent for both years except for the smallest region Corsica. However there are some modifications in the ranking of regions according to total factor productivity level.

The range of index values is quite large: 82 to 149 in 1980 and 76 to 143 in 1985 for total factor productivity. But instead of commenting table 2 alone let's consider simultaneously the map. Classification of regions according to types of farming seems suitable to take into account differentials in total factor productivity. Arable farming achieves the best score it is followed by permanent crop farming. At the opposite there is cattle rearing and fattening, other types being distributed below national average.

A similar calculation at the département level for 1980 depicts the same ranking. Moreover the hypothesis that the category means are equal is rejected at a 1% confidence level using a one way analysis of variance. Nevertheless within category variations are still important and this type of scaling must be considered as an approximation. It provides explicit recognition of the importance of output composition in describing productivity differentials.

Table 2: Regional indexes of productivity for 1980 and 1985
 1980: first row; 1985: 2nd row; France = 100

	Total	partial productivities			
	productivity	materials	capital	land labour	
Ile-de-France	148	113	164	138	186
	143	108	155	136	187
Champagne-Ardennes	149	121	149	113	190
	132	114	129	108	163
Picardie	128	95	128	117	179
	124	93	125	118	175
Haute-Normandie	104	88	113	98	129
	109	93	120	105	134
Centre	115	100	121	87	142
	112	100	115	87	136
Basse-Normandie	94	97	88	98	89
	92	92	100	98	91
Bourgogne	109	112	109	75	115
	111	114	107	78	117
Nord-Pas de Calais	101	76	104	156	136
	104	83	110	147	131
Lorraine	95	98	72	71	106
	91	89	78	71	107
Alsace	111	128	99	157	89
	113	138	86	162	89
Franche-Comté	87	90	87	73	87
	91	95	87	76	91
Pays-de-la-Loire	93	88	77	114	102
	99	88	109	125	109
Bretagne	86	63	66	190	126
	94	63	113	207	135
Poitou-Charentes	87	85	88	84	90
	101	105	90	89	102
Aquitaine	83	88	83	107	66
	95	104	89	123	76
Midi-Pyrénées	79	86	72	73	73
	87	98	73	81	76
Limousin	82	113	60	50	55
	76	100	54	49	53
Rhône-Alpes	92	97	95	107	81
	90	96	89	105	76
Auvergne	83	100	71	56	69
	77	90	63	54	66
Languedoc-Roussillon	114	144	107	124	77
	114	140	122	123	74
Provence-Côte d'Azur	117	124	125	187	91
	121	132	133	192	89
Corse	110	138	167	69	64
	88	100	122	44	56

Evolution from 1980 to 1985 must be considered carefully because some inconsistencies, that we are not able to justify, arise. However it is possible to emphasize some trends. Globally regions oriented towards dairy production, protein rich products, or fruit and vegetables realized the highest total productivity growth whereas regions more specialized in cereals sugar beet or cattle production achieved below the average productivity increases.

A look at regional data shows marked differences in labour decline. By far the largest decrease took place in the Western part (Brittany, Pays-de-Loire, Poitou-Charentes) and the South-Western part (Aquitaine) of the country where agricultural income is relatively low. They achieved a rapid growth of labour productivity and some improvement in total productivity. At the opposite a more moderate diminution of labour in high agricultural income regions like Centre or Champagne accounts for a relative decline of productivity. Substitution of materials, capital and land to labour is still at work so labour migration and demography remain the driving forces behind the increase in total factor productivity.

It would be wrong to jump to the conclusion that there is a convergent path of regional productivities. Previous consideration rely on a very short story, half a decade and moreover regions with very low income have moved back (Limousin, Auvergne).

Arable farming regions give some evidence of a positive relationship between protection and productivity levels. But there are many counterexamples. Mediterranean regions and areas producing quality wine which does not come under the CAP are good ones. Cattle dairying farming regions provide another one since they enjoy a high level of protection but achieve below the average level of total factor productivity.

As it has been mentioned before, there are large differences in productivity within regions. The Centre region which is highly specialized in grain production is a good example of such internal disparities. In 1981, for instance, the index of total factor productivity ranged from 1 to 1.6 between extreme départements (Indre and Eure-et-Loir). The cereal sector has extended during the last decades because very favourable factors have acted but this geographical spreading raises an awkward question. It is concerned with the future of agriculture in less-favoured areas. In relative terms, the cereal industry has enjoyed fast technical progress and high prices. It has implied a perverse regional specialization in so far as many areas do not achieve a sufficient level of productivity.

A price reduction for cereals and other crop products as oilseeds will lead to a decrease in land rent and a giving up of marginal locations. The adjustment of the CAP with a diminution of protection could require major changes in arable farming regions. In our opinion hill farming, and more specifically dairy production in mountain areas, raises a different prospect. On the grounds of economic theory there are arguments to implement conservation policies. They would include incentives to maintain agriculture in these areas.

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