Agricultural productivity in Western Europe

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Summary

The objective of this article is to test two hypotheses concerning agricultural productivity:

1) It is said that productivity of European agriculture is low, but that there are large regional and international differences.

2) It is said that there is a system in these differences: agricultural productivity is high around the North Sea and declines with increasing distance to the sea or altitude above sea level.

In order to be able to evaluate the facts it is necessary to have a yardstick for measuring differences in agricultural productivity. The optimal yardstick for comparisons of agricultural productivity appears to be the net total productivity index. A consequent use of this yardstick leads to results that appear to be in accordance with the two hypotheses.

The problem

One of the problems in economic policy is the question whether the best use is made of the resources available to the nation. The question can be asked whether the resources are distributed in the right way over the sectors of production and are used in an optimal way within each sector. Clearly this is a 'productivity' problem. It is said that neither the distribution of resources over the sectors, nor the use that is made of them within each sector is optimal indeed in European countries. One of the most important examples is agriculture, where too much labour is allocated and suboptimal use is made of the resources available. Thus, productivity of European agriculture should be low.

Some facts mentioned by Yates (Ref. 16) indicate that there are large differences in agricultural productivity within Western Europe. Probably there is an explanation for a system in these differences. Baade (3, 4) explained why some regions in eastern England, northern and western Holland, northern Germany and Denmark in 1850 had the highest standard of agricultural production seen from a technical point of view. In these regions technical advance was made first, resulting in considerable progress. The other regions followed later. It was not until 1920 for example that equal standards of farming were reached in the southern part of Germany. The higher the altitude, the longer it took for progress to arrive. I think it is reasonable therefore to state that agricultural productivity in general is the highest in the countries around the North Sea and declines with increasing distance from the sea or altitude above sea-level.

The objective is to test these two hypotheses about agricultural productivity in Western Europe. In order to be able to evaluate the facts it is necessary to have a method for measuring differences in agricultural productivity.

Method of measurement

For comparison of productivity levels, it is necessary to have a) an adequate yardstick for productivity, b) a base for comparison and c) facts and figures about agricultural production in Europe.

As a result of many studies (12, 13, 18, 20) in the field of productivity measurement, 'net total productivity' (being the relationship between net product and factor input) arose as the optimal concept for comparison of the level of productivity 'in time' or 'in space'. This concept, however, is not used frequently especially not in geografic comparisons.

Not for chauvinistic but only for practical reasons, Dutch agriculture was chosen as a basis for comparison. Within Dutch agriculture, considerable differences in productivity exist, as is illustrated in Table 1.

| Agricultural region | Farm size (ha) | | | | | |
|---|----------------|-----|------|-------|-------------|--------|
| | average 4-100 | 4_7 | 7–15 | 15_30 | 30_50 | 50-100 |
| The Netherlands | 100 | 75 | 92 | 113 | 125 | 137 |
| Riverclay regions | 85 | 70 | 80 | 97 | 106 | 115 |
| Sandy soil regions | 89 | 75 | 87 | 101 | 111 | 120 |
| Grassland areas | 107 | 83 | 95 | 117 | 125 | 134 |
| Peat recl. areas | 125 | | 114 | 128 | 135 | 148 |
| Marine loam regions Agriculture in horticul- | 133 | 89 | 117 | 132 | 136 | 144 |
| tural regions | 133 | - | 124 | 138 | 1 77 | |

Table 1 Differences in productivity level within Dutch agriculture 1 1960/1961. National average = 100

¹ Excl. specialized horticulture. Source: (19).

As a matter of fact, there is a distribution of the farms over the classes of productivity. The frequency distribution of farms is skew in the sense that the greater part of the farms (75%) have a productivity level under the national average, the latter being a measure of the 'central tendency' of the distribution. In other countries I suppose there will be such frequency-distributions also. International comparisons of productivity therefore is essentially a comparison of the 'position' of these frequencydistribution curves. It is possible to approximate the differences in position by estimates of the differences in the mean.

Comparison of a country's agricultural productivity with that of The Netherlands is made in two steps. This procedure starts with an estimation of the well-known net labour productivity, the latter being net product (= gross product-depreciations) per unit of labour. The second step is to take into account the differences in 'capital-

intensity' that is the quantity of capital goods and land per man. This second step is necessary, as can be demonstrated with the following example. Two countries are in exactly the same conditions; hence, the level of agricultural productivity is the same. Suppose that in one of these countries the price of capital goods (such as tractors and machines) and the rate of interest decline. Probably capital is substituted for labour. After that there will be a difference in labour productivity. No technical progress was made, only a substitution process was carried out, so the level of productivity must still be the same. Consequently the net labour productivity index overestimates the difference in the level of productivity for it indicates a difference where none does exist. Net product was the same before and after this substitution process; there was less labour but more capital. However, only the decrease in labour input was taken into account but the increase in capital was fully omitted. So the net labour productivity index is not an accurate estimate of productivity. The net total productivity index takes into account both the changes in labour input and in capital input, hence it constitutes an efficient estimate of productivity. The index of net total productivity has the following formula:

Net total productivity = -

ctivity =
$$\frac{1}{(1-\beta)L + \beta C}$$
 : $\frac{1}{(1-\beta)L_b + \beta C_b}$

in which N = index of net product, L = index of labour input, C = index of capital input (incl. land), $\beta =$ share of capital in factor costs, and b indicates the basis of comparison being Dutch agriculture. Measurement showed β to be 20% in 1958/1959 (16), so it follows that:

 N_{ι}

Net total productivity = net labour productivity $\times \frac{0.8 + 0.2k_b}{0.8 + 0.2k}$

Ν

in which k = index of capital intensity (capital per man).

So after having determined the labour productivity index, the next step is to estimate the index of capital intensity in order to arrive at the net total productivity index, which is in my opinion the optimal index for comparisons of the level of productivity.

Differences in net labour productivity within West-European agriculture

A comparison of *British and Dutch agriculture* has been made by the Dutch Central Bureau of Statistics (24). Its findings are summarized in Table 2.

Table 2 Net labour productivity index of British agriculture 1958/1959

| The Netherlands | <i>U.K.</i> |
|-----------------|---|
| | |
| 5741.5 | 13,090 |
| 2547.0 | 8,643 |
| 3194.5 | 4,447 |
| 437,500 | 918,800 |
| = 100 | 66 |
| | The Netherlands 5741.5 2547.0 3194.5 437,500 = 100 |

Source: (24)

There are some uncertainties in this estimation, especially regarding the index for depreciations and the number of man years. The margin of uncertainty is rather wide, it is possible to arrive at a net labour productivity index of 75, by only a slight, though reasonable alteration in the estimation of the index of depreciations. It is remarkable that gross labour productivity of British agriculture was only 20% lower than the Dutch whereas the *net* labour productivity was 34% lower, giving depreciations a rather important and unexpected influence on the productivity index.

In order to compare *Danish and Dutch agriculture* some use was made of a statistical study by Jørgensen (15). In this study, a comparison was made of agricultural labour productivity in both countries, the basis, however, being Danish agriculture. With the aid of statistical material in this study it was possible to perform a calculation with Dutch agriculture as weight basis (Table 3).

| | | The Netherlands | Denmark |
|----------------------------------|---------------|-----------------|-------------|
| Value in Dutch prices (mln guild | ers) of : | | |
| Arable products | | _ | 502 |
| Animal products | | - | 3,882 |
| Horticultural products | | — | 323 |
| I | Final product | 6,510 | 4,707 |
| Non factor input | | 3,305 | 1,672 |
| 1 | Net product | 3,215 | 3,035 |
| Number of man years | | 381,000 | ca. 300,000 |
| Net labour productivity index | | = 100 | 120 |

Table 3 Net labour productivity index for Danish agriculture 1960/1963

Sources: (8, 15 and 17)

To arrive at a comparison for 1958/1959 the rate of progress in labour productivity was determined. Danish argiculture increased with 28% and Dutch agriculture with 22% (15). So in 1958/1959 Danish agricultural labour productivity was approximately 15% higher than the Dutch.

The comparison of *Swedish and Dutch* agriculture is based on data supplied by Jordbrukets Utredningsinstitut in Stockholm. After discussing the matter with Dr. Holmström I calculated the index in Table 4.

The comparison of *German and Dutch* agriculture (Table 5) is based on a study of Rustemeyer (20).

The difference with Rustemeyer's calculation is the difference in the price index of products. He calculated an index of 86. I think this index is too high, since most of the products in Holland were more than 14% cheaper than in Germany. Milk was 16% cheaper, sugar beets more than 20%, oats about 25% and wheat more than 30% (8). The resulting difference in labour productivity was Rustemeyer's index: 46, and according to my estimation it is 38 to 42. In the period 1958/1959-1960/1961 agricultural labour productivity rose equally fast in both countries so we may estimate the net labour productivity index for Germany to be 40.

| | | The Netherlands (1958) | Sweden (1958/1959) |
|--|-------------------|---------------------------|-----------------------|
| Value in Dutch prices (m | ln guilders) of : | | |
| Crop products | | · | 488.1 |
| Animal products | | — | 2,284.9 |
| | Final output | | 2,773.0 |
| Non factor input | | <u> </u> | 1,536.3 |
| | Net product | 3,281 | 1,246.7 |
| Number of man years | | 440,000 | 295,000 |
| Correction factor for diff in hours per man year Net labour productivity | erence | = 100 | 1.2 67 |

Table 4 Net labour productivity index of Swedish agriculture 1958/1959

Sources: (17) and personal communications

Table 5 Net labour productivity of German agriculture 1958/1961

| | The Netherlands | Germany |
|--|---------------------|----------------|
| Value of final product per man year in D.M. Value of net product per man year in D.M. | 15,436 8,490 | 8,857 5,108 |
| Price index of final products Price index of non factor inputs | 75 <u>80</u> 100 | = 100 = 100 |
| Net labour productivity | = 100 | 38_42 |

Sources: (8, 20)

Table 6 Estimates of Belgian agricultural labour productivity in 1960

| | The Netherlands | Belgium |
|------------------|---|-----------------|
| n guilders) of : | | |
| | | 1,200 |
| | | 2,470 |
| Final product | _ | 3,670 |
| | | 1,405 |
| Net product | 3,652 | 2,165 |
| | 418,000 | 348,490 |
| | = 100 | 71 |
| | In guilders) of : Final product Net product | The Netherlands |

Sources: (1, 17 and 21)

The comparison of *Belgian and Dutch* agriculture was not easy, because there were different statistical data for the same thing.

Table 6 gives a rather rough estimation. In Belgium the sector accounts for agriculture

will be improved, in the future it will be possible to give better estimates. Taking into account that productivity of Belgian agriculture grew faster than the Dutch, the productivity index for 1958/1959 was about 70.

For the comparison of *French and Dutch* agriculture the same procedure was followed (Table 7).

Table 7 The net labour productivity index of French agriculture 1960

| The Netherlands | France |
|-----------------|-----------------|
| | |
| <u> </u> | 16,920 |
| | 11,396 |
| <u> </u> | 28,316 |
| — | 8,590 |
| 3,652 | 19,726 |
| 405,200 | 4,071,000 |
| = 100 | 54 |
| = 100 | 58 |
| | The Netherlands |

¹ Full-time employment

A = all persons weighted equally; B = women weighted for 2/3 of a man. Source: (1)

| | Labour productivity ¹ in 1958/1959 | Progress in labour productivity ² per year in 1950/1960 (growth rate in %) |
|-----------------|--|---|
| The Netherlands | = 100 | 3.6 |
| Denmark | 115 | 5.7 |
| Belgium | 70 | 7.5 |
| Sweden | 67 | 3.0 |
| U.K. | 66 | 4.7 |
| France | 58 | 2.7 |
| Germany | 40 | 7.5 |

Table 8 Agricultural labour productivity in Western Europe

¹ Net product per unit of labour

² Gross product per unit of labour, source: (22)

There are several difficulties in this estimation, about the same as in the other ones, but now more serious. There are more products for example which the countries have not in common and the price relations are not fully known, nor the number of man years. According to the fact that agricultural productivity in France rose somewhat slower than in The Netherlands, the index for 1958/1959 may be 55–59. We can now summarize the findings about labour productivity of agriculture in

Western Europe (Table 8).

In order to determine the index of net total productivity the next step must be the estimation of the differences in capital intensity.

Differences in capital intensity within West-Europeana griculture

The estimation of the differences in capital intensity is the most difficult part of the whole computation. According to findings of the Dutch Central Bureau of Statistics (24) the quantity of machinery and land in British agriculture was about 3 times as large as in Dutch agriculture.

Jørgensen produced some statistics indicating a higher capital intensity for Danish agriculture because there is more land and more machinery per man year available (15).

According to data of Dr. Holmström, Swedish agriculture is very capital intensive. The number of tractors per man year in 1958/1959 was about 0.48 against 0.15 in The Netherlands. The acreage of land per man year in Sweden was about 12.5 ha against ca. 5.5 ha in The Netherlands.

According to data of Rustemeyer, German agriculture was also more capital intensive than Dutch agriculture; the acreage of land per man was lower, but the quantity of machinery and tractors much higher (20).

According to figures of Serroen (21), Belgian agriculture was less capital intensive e.g. the acreage of land per man year was lower (4.9 ha) and the number of tractors (0.14) also.

In Table 9, some indices of capital goods and land per person occupied in agriculture are shown.

On the basis of these facts from literature and statistical publications, a rough estimate was made for the differences in capital intensity. It was tried also to determine the rate of progress in capital intensity. An estimation was possible for the increase of capital goods per man for the period 1950–1960, as given in Table 10.

| | Land | Tractors | Milking machines |
|-----------------|-------|----------|------------------|
| The Netherlands | = 100 | = 100 | = 100 |
| Denmark | 165 | 218 | 328 |
| Belgium | 110 | 100 | 109 |
| U.K. | 264 | 318 | 127 |
| France | 142 | 127 | 29 |
| W. Germany | 84 | 180 | 100 |

Table 9 Land and machines per occupied person in 1961

Source: (8)

Table 10 Estimates of capital intensity within Western European agriculture

| | Capital intensity 1 | Rate of progress in capital intensity ² (% per year) 1950/1960 |
|-----------------|---------------------|--|
| The Netherlands | = 100 | 3.2 |
| Denmark | 180 | 2.0 |
| Belgium | 95 | 4.7 |
| U.K. | 280 | 4.1 |
| Sweden | 260 | 2.6 |
| France | 120 | 7.5 |
| W. Germany | 120 | > 8.0 |

¹ Capital goods and land per man year

² Capital expenditure at constant prices per mean year, source: (22)

It is clear from these figures that there are large differences in capital intensity and that the latter is increasing everywhere. The United Kingdom has the most capitalintensive agriculture in Western Europe. Swedish farming comes next to the British in degree of mechanisation and capital intensity. It is possible now to put the elements together in order to estimate the differences in productivity.

Differences in net total productivity within West-European agriculture

Now it is possible to calculate the indices of net total productivity (Table 11). According to these estimates, there are considerable differences in productivity within European agriculture. It is admitted that wide margins of error and uncertainty exist in these estimates. Only a discussion about this subject can provide us with better estimates. Perhaps it is possible for O.E.C.D. to organize such a study, since much international cooperation and statistical evidence is needed to perform this work.

| Country | Net labour productivity | Correction factor 1 | Net total productivity | Rate of progress per year ² during the 1950's (%) |
|-----------------|----------------------------|------------------------|---------------------------|--|
| The Netherlands | 100 | 100/100 | 100 | 3.2 |
| Denmark | 115 | 100/116 | 99 | (4.7) |
| Belgium | 70 | 100/100 | 70 | (7.0) |
| France | 58 | 100/104 | 56 | (3.7) |
| Sweden | 66 | 100/132 | 50 | (2.7) |
| U.K. | 66 | 100/136 | 49 | (2.0) |
| W. Germany | 40 | 100/104 | 38 | 5.5 |

Table 11 Net total productivity of agriculture in Western Europe 1958/1959

¹ (0.8 + 0.2 k_b) / (0.8 + 2k) in which k = capital intensity, $k_b = 1$

² Percentages between brackets are rough approximations.

Sources: Table 8 and 10; (13, 20)

These differences in productivity give only an estimation of the differences in the position or central tendency of the distribution of the farms over the classes of productivity. In view of the finding that in The Netherlands 75% of the farms have a level of productivity under the national average, most farms in Europe can be expect to have very low levels of productivity. There really is a productivity problem in European agriculture. Although considerable improvement is made in agricultural productivity in each country, the differences will remain for a long time, even when the rate of progress in the period 1950–1960 will continue. Probably these differences existed already long before the second world war, because from Table 11 it follows that in 1950 the differences in the level of productivity between the countries were even greater than in 1958/1959. It is moreover not unreasonable to assume that the level of productivity in 1950 was as high as in 1939, since not much progress was made in this decade of war and reconstruction; progress during the depression of the 1930's was also slight (18).

These facts generally support the hypothesis mentioned in the first paragraph of this paper. A closer look at the economic results of farming will give us more details.

Regional differences in agricultural productivity

In The Netherlands the most efficient and productive farms are situated in the western and northern parts of the country. In general, the farther southeastwards we go, the lower the level of productivity is (19).

When we pass our eastern border and arrive in the north of Germany we notice that the average level of productivity decreases. In 1958/1959 net value added was on the average 5260 D.M. per man year (5) or 4750 Dutch guilders; in The Netherlands this amounted to 7200 Dutch guilders. In addition, the price level and capital intensity in The Netherlands were considerably lower than in Germany. When we continue our journey in southeasterly directions we arrive in the southern part of the Federal Republic. Here the average net value added per man was again 15-20%lower than in the north of Germany. Labour income was also lower than in The Netherlands (5).

When we start again in the western part of The Netherlands and move in a southern direction, we arrive in agricultural regions of Belgium which are equally productive. More eastwards in the hillier parts of this country, productivity is lower. This is reflected in the results of farming. According to Janssens (14), income derived from farming in the hillier parts of Belgium were (with 40%) well below the average.

We continue in southerly directions and pass the French border. We arrive in the north of France, a region with very efficient farming methods.

According to Yates (16), you will find here large farms, run as commercial enterprises, specialising in sugar beet, wheat and livestock. This, however, is not the average picture for agriculture in France, only for the best part of French agriculture. The other extreme type is part-time farming on 2 and 3 ha farms in the mining and industrial districts. Between these extremes, the majority of French farms are mixed enterprises farming 20–60 ha. Thus, the level of productivity is not everywhere as high as e.g. in the Île de France. The national average is lowered by farmers in less favourable regions, e.g. in the Massif Central or Brittany or in the southwestern departments.

When we go to the other side of the North Sea namely to eastern England, we see a highly productive type of farming on large, capital-intensive farms. This, however, is not the case in all parts of the British Isles. In Cornwall, Wales, the Penninies, the Highlands and Ulster, farming is far less efficient and profitable. This is reflected in the farming results as reported by Hirsch (10).

In Denmark, the average level of productivity in farming is as high as in The Netherlands. Going northeastwards we arrive in Sweden. According to Lamartine Yates (16) the farmers in the extreme south are probably as productive as the Danish, but the national average is pulled down by the many small farmers operating on the less fertile soils and the harsher climate of central Sweden. This is clearly reflected in the income derived from farming as indicated by Holmström. In 1958/1961 earned family income in the upper part of northern Sweden e.g. was about 45 percent of that in the plains of South Götaland in the same acreage class (11).

We may conclude therefore that the most efficient or productive agriculture is situated around the southern part of the North Sea; the greater the distance from this region or the higher above sea-level the lower is generally the level of agricultural productivity. Besides some exceptions due to part-time farming and less favourable conditions, we find the most efficient and productive farming within a circle around Rotterdam, having a radius of some 400 miles. The part of Europe included is just the densely populated, industrial region of Europe. So we find the most efficient agriculture in the immediate neighbourhood of the great industrial centres, probably not a merely accidental situation.

| The Netherlands | Canada |
|-----------------|---------------------|
| | |
| | 9,674 |
| | 6,099 |
| t | 15,773 |
| — | 5,744 |
| 3,281 | 10,029 |
| | |
| 440,000 | 712,000 |
| = 100 | 190 |
| = 100 | 380 |
| = 100 | 120 |
| | The Netherlands |

Table 12 Productivity of Canadian agriculture 1958

Sources: (7, 9, 17 and 23)

| Table | 13 | Production | of | U.S . | agriculture | 1958 | |
|-------|----|------------|----|--------------|-------------|------|--|
| | | | | | | | |

| | Value | | | | Value | |
|------------------------|------------------------------|--------------------------------------|---------------------|------------------------------|--------------------------------------|--|
| | in U.S prices (mln \$) | in Dutch prices (mln guilders) | | in U.S prices (mln \$) | in Dutch prices (mln guilders) | |
| Livestock products | | | | | | |
| Cattle and calves | 7,403 | 33,239 | Feed purchased | 4,512 | 19,763 | |
| Hogs | 3,416 | 10,863 | Livestock purchased | 2,680 | 11,738 | |
| Sheep and lambs | 359 | 1,400 | Fertilizer and lime | 1,305 | 3,915 | |
| Dairy products | 4,562 | 14,188 | Depreciation | 3,988 | 15,952 | |
| Eggs | 1,771 | 8,271 | Repairs etc. | 3,788 | 15,152 | |
| Chickens | 1,148 | 4,420 | Miscellaneous | 2,468 | 9,378 | |
| Turkeys | 367 | 1,108 | | 10.000 | | |
| Wool | 82 | 324 | | 19,275 | 77,927 | |
| Other livestock | 193 | 724 | Net product | 14,285 | 57,817 | |
| Crop products | | | | | | |
| Food grains | 2,510 | 11,345 | | | | |
| Feed crops | 2,781 | 15,573 | | | | |
| Cotton (lint and seed) | 2,134 | 8,109 | | | | |
| Oil bearing crops | 1,424 | 5,411 | | | | |
| Tobacco | 1,008 | 3,830 | | | | |
| Fruits and tree nuts | 1,503 | 5,711 | | | | |
| Vegetables | 1,589 | 6,038 | | | | |
| Sugar crops | 235 | 1,105 | | | | |
| Other crops | 1,075 | 4,085 | | | | |
| Final product | 33,560 | 135,744 | Total | 33,560 | 135,744 | |

Sources: (2, 17)

The low level of agricultural productivity in Western Europe

The problem we have to face now is the question whether the level of agricultural productivity in Europe is low indeed as stated in the introduction. It is clear that there are large differences within Western Europe, especially when compared with The Netherlands and Denmark.

The question remains whether agricultural productivity in these countries is exceptionally high or not. A solution to this problem can be reached by comparing the European *top* with the *average* of North American agriculture including both the United States and Canada.

The comparison between Netherland's and American agriculture is not easy due to many differences between the countries e.g. many products that the countries have not in common. This comparison with North American agriculture starts with an estimation of the net total productivity index of Canadian agriculture (Table 12).

Canadian agriculture had a much higher net labour productivity than Dutch agriculture, but the capital intensity was also much higher with about two times as many milking machines, four times as many tractors and about five times as many acres of land per man. The capital intensity was about 3.8 times as high as in The Netherlands. This resulted in a net total productivity index of 120.

Next, the estimation for U.S. agriculture was carried out. In Table 13, the index of production is given.

The net labour productivity could be calculated in the usual way (Table 14). In 1958 net labour productivity of U.S. agriculture was more than twice as high as in The Netherlands. Capital intensity, however, was much higher also; there were more acres of land, tractors and machines per man (2, 17). A conservative estimate gave a capital intensity four times as high as that in The Netherlands. Using the formula for the computation of the net total productivity index, I found an index of 131.

| | The Netherlands | <i>U.S</i> . |
|--|-----------------|--------------|
| Net product (Dutch prices, in mln guilders) | 3,281 | 57,817 |
| Man hours (\times mln) | 1,335 | 11,103 |
| Net labour productivity | = 100 | 210 |
| Capital intensity | = 100 | 400 |
| Net total productivity | = 100 | 131 |
| Rate of progress per year in net total productivity during the 1950's (%) | 3.2 | 4.0 |

Table 14 Productivity of U.S. agriculture 1958

Sources: Table 12; (2, 6, 8, 13 and 17)

Thus it can be said that the average level of productivity in Canadian and U.S. agriculture lies about 20 and 30%, respectively above the average in The Netherlands and Denmark and is therefore about two and an half times as high as the average of Western Europe. This implies a relatively low level of agricultural productivity and farming efficiency in the larger part of Western Europe.

Regarding the differences in the level of productivity and the almost equal rates of progress this situation will probably be rather persistent.

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