PROCEEDINGS OF THE NINTH INTERNATIONAL CONFERENCE OF AGRICULTURAL ECONOMISTS

HELD AT
TEEKKARIKYLA, OTANIEMI
FINLAND
19–26 AUGUST 1955

THE IMPLICATIONS OF TECHNICAL CHANGE IN AGRICULTURE

LONDON
OXFORD UNIVERSITY PRESS
NEW YORK TORONTO
1956

THE IMPACT OF TECHNICAL CHANGE ON THE EMPLOYMENT SITUATION WITHIN AGRICULTURE AND ON THE OCCUPATIONAL STRUCTURE OF THE POPULATION

JØRGEN PEDERSEN

University of Aarhus, Denmark

IT is a well-known fact that in the north-western and culturally affiliated countries for many decades there has been a continual reduction in the percentage of adults occupied in agriculture. In most of these countries there has even been a decline in the absolute labour force, and this development has taken place in spite of a rapidly growing population, an increased consumption *per caput* of agricultural products, and an increase in total production.

Until the outbreak of World War II the emigration from agriculture proceeded at a rather low and steady rate, but with the outbreak of the war in most countries the rate of decline began to accelerate. In several countries there has been a decline in the number of adult males occupied in agriculture of between 20 and 30 per cent. during the last fifteen years.

There are a few exceptions to this pattern. The most outstanding perhaps are Great Britain and Denmark. In Great Britain a heavy emigration from agriculture started in the middle of the nineteenth century and continued to the middle 1930's. Then there was an increase until 1947, when a renewed reduction took place although at a lower pace than in most other countries. In Denmark on the other hand there was a slow increase in the labour force during the twentieth century until about 1930. This was followed by a very slow decline during the thirties, but from 1940 there has been a precipitate fall in the number of adults employed in agriculture.

The special British development is mainly due to the fact that Britain during the free trade era of the nineteenth and twentieth centuries developed a profitable export trade in finished industrial goods with which domestic agriculture could not compete. The result was that industry drew labour from the land and the country relied increasingly on imports to feed her growing population. From the middle thirties, however, Great Britain entered upon a protective policy for her agriculture, first in order to mitigate the heavy

unemployment of the thirties and later to achieve greater self-sufficiency owing to war conditions.

The peculiar development of Denmark was mainly due to the fact that she met the catastrophic fall in grain prices after 1875, not by protective tariffs, but by developing animal production partly on the basis of an enormous increase in fodder crops, partly on the basis of imported grain. She became a heavy exporter of animal products and even today after a great reduction in the agricultural labour force she exports more than half her total net agricultural product. Thus when Denmark maintained her agricultural labour force, and even increased it somewhat in the first decades of the twentieth century, it was due not to lower efficiency in agriculture but to a development of the export trade in agricultural products.

The Structural Change during the last Fifteen Years

The explanation of the general trend which I have described is fairly obvious and well known, but that does not apply to the cause of the spectacular decline in the agricultural labour force which, apart from Great Britain, has developed during the last fifteen years.

It is generally said to be due to mechanization, which has rendered a great part of the former labour force superfluous. It is a fact, however, that although there may have been some improvement in basic technical devices, none of them was invented during World War II. Tractors existed even before World War I and combines had reached a fair stage of perfection during the 1920's. The invention of agricultural machinery together with other technical improvements in agriculture could perhaps serve to explain some of the smooth and moderate reduction in the labour force during the inter-war period but not the structural change taking place during and after World War II.

It is true that agriculture has been increasingly mechanized, but that is not because new inventions have been made, but because economic conditions have made it increasingly profitable to employ the technical devices already at hand. The same conditions have also stimulated inventions and the improvement of agricultural machinery and techniques, but this has not been a primary cause, but a secondary and accelerating factor.

What then are the *economic changes* which have taken place during this period? My tables give certain figures for selected countries, namely U.S.A., Great Britain, Sweden, and Denmark.

In Table I (page 249) there are two columns for each country, the first giving the relative wage of agricultural labour and the second

TABLE I

Relative Wages in Agriculture (column I) and the Unemployment Percentage (column II)

Year	U.S.A.		Great Britain			Sweden			Denmark	
	I*	II†	I‡	II§		I‖	II¶		I**	II††
1929	0·43	3·2	0·97	..	8·2	0·48	..	10·7	0·61	15·5
1930	0·41	8·7	0·97	..	11·8	0·46	..	12·2	0·56	13·7
1931	0·34	15·9	0·99	..	16·7	0·45	..	17·2	0·52	17·9
1932	0·29	23·6	0·99	..	17·6	0·44	..	22·8	0·47	31·7
1933	0·26	24·9	0·99	..	16·4	0·45	..	23·7	0·49	28·9
1934	0·24	21·7	0·99	..	13·9	..	..	18·9	0·47	22·1
1935	0·26	20·1	1·01	13·1	..	0·45	..	16·1	0·54	19·7
1936	0·27	16·9	0·99	..	11·2	0·43	..	13·6	0·56	19·3
1937	0·28	14·3	0·99	8·5	9·3	0·51	10·8	11·6	0·59	21·9
1938	0·27	19·0	1·00	9·5	10·2	0·51	10·9	11·8	0·58	21·3
1939	0·26	17·2	1·00	8·0	8·8	0·52	9·2	..	0·60	18·4
1940	0·26	14·6	1·01	5·0	..	0·52	11·8	..	0·57	23·9
1941	0·28	9·9	1·18	1·5	..	0·57	11·3	..	0·66	18·4
1942	0·31	4·7	1·34	1·0	..	0·59	7·5	..	0·67	15·1
1943	0·37	1·9	1·29	0·5	..	0·63	5·7	..	0·66	10·7
1944	0·42	1·2	1·32	0·5	..	0·64	4·9	..	0·65	8·3
1945	0·46	1·9	1·34	1·0	..	0·69	4·5	..	0·80	13·4
1946	0·47	3·9	1·34	2·5	..	0·68	3·2	..	0·77	8·9
1947	0·44	3·6	1·43	2·0	..	0·65	2·8	..	0·78	8·9
1948	0·43	3·4	1·47	1·5	..	0·71	2·8	..	0·80	8·6
1949	0·40	5·5	1·50	1·6	..	0·71	2·7	..	0·78	9·6
1950	0·38	5·0	1·47	1·6	..	0·72	2·2	..	0·81	8·7
1951	0·39	3·0	..	1·2	..	0·65	1·8	..	0·74	9·7
1952	0·40	2·7	..	..	..	..	..	..	0·74	12·5
1953	0·38	2·5	..	..	..	..	..	..	0·69	9·2
1954	0·37	..	..	..	..	..	..	..	..	..

* Average agricultural wages as percentage of average hourly earnings in total manufacturing. (*Source: Economic Report of the President* 1955.)

† Percentage of civilian labour force. (*Source*: as above.)

‡ Farm wages/all wages (1938 = 100). (*Source*: E. Meyer, *Agricultural Labour in England and Wales*, Part II, University of Nottingham School of Agriculture, 1951.)

§ Wholly unemployed as percentage of insured. (*Source*: *International Labour Review.*)

‖ Daily earnings in agriculture/hourly earnings in industry multiplied by 8. (*Source*: *International Labour Review and Statistisk Arsbok.*)

¶ As §.

** Earnings of day labourers in agriculture (9 hours)/computed daily earnings (8 hours) for unskilled construction workers in the provinces. (*Sources*: *Statistiske Efterretninger.*)

†† Unemployed as percentage of insured. (*Sources*: *Statistiske Efterretninger.*)

the unemployment percentage. Chart I gives the figures from Table I compared with figures for the agricultural labour forces taken from Table II and shows the following salient points:

1. Roughly speaking there is a clear negative correlation between

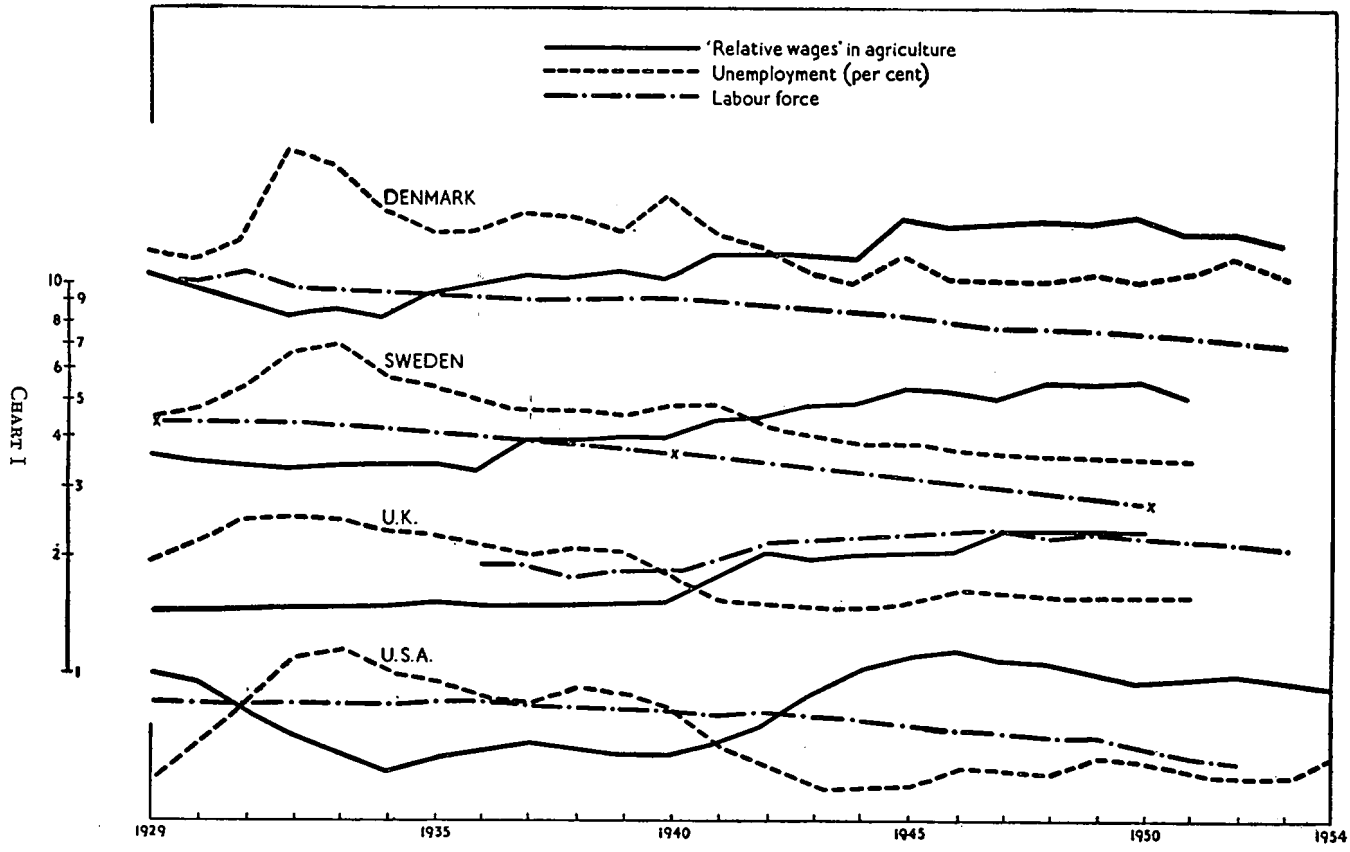

'Relative wages' in agriculture
Unemployment (per cent)
Labour force
DENMARK
SWEDEN
U.K.
U.S.A.
10
9
8
7
6
5
4
3
2
1
1929
1935
1940
1945
1950
1954

CHART I

TABLE II

'Real Price' of Agricultural Labour (column I) and Agriculture Labour Force (column II)*

	U.S.A.		*Great Britain*		*Sweden*		*Denmark*	
Year	*I*†	*II*‡	*I*§	*II*‖	*I*¶	*II***	*I*††	*II*‡‡
1929	0·73	10,450	..	..	..	..	..	..
1930	0·82	10,340	..	..	..	1,040	3·85	542
1931	0.85	10,290	..	..	..	..	4·79	533
1932	0·86	10,170	..	..	..	..	5·66	524
1933	0·72	10,090	..	..	..	..	5·31	517
1934	0·63	9,900	..	..	..	..	4·64	504
1935	0·58	10,110	1·00	..	0·60	..	4·19	488
1936	0·60	10,100	0·99	751	0·56	..	4·37	484
1937	0·64	9,820	0·94	742	0·64	..	4·52	481
1938	0·77	9,690	0·98	697	0·67	..	4·44	478
1939	0·81	9,610	0·98	711	0·66	..	4·75	479
1940	0·80	9,540	0·87	712	0·60	860	4·64	478
1941	0·80	9,100	0·83	759	0·57	..	3·77	474
1942	0·81	9,250	0·95	824	0·61	..	3·70	470
1943	0·92	9,080	0·94	843	0·67	..	3·88	458
1944	1·09	8,950	0·99	863	0·70	..	4·46	451
1945	1·17	8,580	1·02	887	0·80	..	5·01	442
1946	1·10	8,320	1·03	889	0·85	..	6·00	434
1947	0·97	8,266	1·00	892	0·90	..	6·32	412
1948	0·96	7,973	1·04	850	1·00	..	5·64	398
1949	1·07	8,026	1·04	855	1·01	..	5·36	402
1950	1·03	7,507	1·01	843	1·04	640	5·63	397
1951	0·98	7,054	..	812	1·01	..	5·91	390
1952	1·10	6,805	..	804	..	..	6·00	380
1953	1·24	..	..	780	..	..	5·92	372
1954	1·28	..	..	..	..	..	6·40	362

* Wages in agriculture/price of agricultural products (Index). (*Source* (for wage figures): as in Table I except for Denmark.)

† Prices from *Economic Report of the President* (1947–9 = 100).

‡ Employed in agriculture 14 years of age and over (1,000's) (Source as 1).

§ Agricultural prices, all products (*Annual Abstracts of Statistics* no. 87, 1938–49, supplemented from *Monthly Digest*) (1936–8 = 100).

‖ Numbers employed in agriculture in Great Britain (100's) (*Monthly Digest*).

¶ Wholesale prices of farm products (*Statistical Yearbook 1953*, published by United Nations) (1948 = 100).

** *Statistisk Arsbok.*

†† The price per man-day divided by an index for prices of products sold by farms. (1935 = 100) (*Undersogelser vedrørende landbrugets driftsforhold.* Landokønomisk Drifts-bureau, Københavh). Crop year.

‡‡ Number of 'full year employed' in agriculture (1,000's) (*Statistisk aarbog*). Crop year.

Number of tractors per 1,000 ha.

	U.S.A.	*Great Britain*	*Sweden*	*Denmark*
1930 .	4	2	..	..
1938 .	7	4	5	1
1945 .	12	15	8	1
1952 or 53	20	27	21	16

Source: *European Agriculture, A Statement of Problems*, Geneva, 1954.

relative wages and the unemployment percentage. This relationship, however, is much more marked in the Danish and U.S. curves where it is to be found in great detail, than in the curves for Sweden and Great Britain.

2. With regard to Great Britain two things should be noted: (*a*) During the whole period legal minimum wages were fixed, until the outbreak of the war, roughly proportional to industrial wages. From that date it was necessary to raise relative wages in order to increase the labour force. (*b*) The increase in relative wages was not so great as in other countries, presumably because they had been prevented from falling during the depression.

3. In Sweden relative wages, too, proved rather rigid during the depression owing, I believe, to government interference. This also explains the abrupt rise in the middle thirties. Although there has been a strong decline in the labour force, it has not been possible to prevent a considerable rise in relative wages, as unemployment disappeared.

4. In U.S.A. from 1945, in Sweden from 1948, in Denmark from 1950 in spite of a continuous high level of employment there has been a fall in the trend of relative wages. I shall return to this later.

5. Chart 1 does not support the theory that mechanization has been the cause of the fall in the agricultural labour force. Mechanization must mean a fall in the demand for labour, so that if that theory were valid we should have had a continuous fall in relative wages during the whole period and increasingly so with the increase in mechanization. This, however, has been far from the case. The process of mechanization was extremely slow or absent during the depression, when wages were falling, and increased after the rise in wages had set in, and with a time lag.

6. We have seen from the chart that relative wages are dominated by unemployment. This connexion is not very difficult to explain. Wages have always been considerably more rigid in industry than in agriculture, and when trade unions are dominating the labour market outside agriculture, this difference, of course, becomes much

more marked. If you have a situation in which the natural increase in population (and perhaps a little more) normally emigrates from agriculture, unemployment in the industrial sector will serve as a barrier to normal emigration, and the supply curve of labour in agriculture is shifted to the right. If simultaneously there is a relative fall in agricultural prices, combined with the invention of more advanced technical devices, the demand curve for labour is shifted to the left. As agricultural wages in all countries where they are not legally fixed are generally very flexible, the result is that they fall heavily.

When, on the other hand, unemployment in the industrial sector declines, people take the opportunity to leave agriculture, and when employment outside the agricultural sector becomes almost unlimited i.e. when there is full employment, emigration accelerates to such an extent that the difference in the level of real wages of the two sectors becomes only sufficient to cover the margin necessary to maintain the continual stream of redundant labour from agriculture. Thus, broadly speaking, until some time after the war the behaviour of the series in the table which represents relative agricultural wages is mainly explained not by demand for labour but by supply of labour. The reversal of the trend after the war, first in U.S.A., later in the other countries, must be explained, however, by changes in demand. This has been a period of a heavy acceleration of the mechanization process, constituting, of course, a reduced demand for labour. During this period, on the other hand, there has been no change in supply apart from a couple of brief periods of slight industrial depression. There can be no question, therefore, that the fall in relative wages in recent years has been due to a reduction in demand.

On the basis of the evidence so far advanced I suggest the following order of causation:

1. The high level of unemployment outside agriculture during the thirties increased the supply of labour in agriculture and caused a fall in wages, in so far as that was not prevented by legal minimum wages, such as in Great Britain. (Such fixing of minimum wages must lead either to lower employment and production than would otherwise have been the case, or to a rise in agricultural prices.) The fall in agricultural wages would be in proportion to the degree of organization of the agricultural labour market. This, I think, explains why the fall in relative wages in Sweden in the thirties was less than, for instance, in Denmark and U.S.A., where the labour market in agriculture was practically unorganized.

2. This fall in wages retarded the introduction of new and improved machinery. The price of machinery being mainly determined by industrial wages rose relatively with the fall in relative agricultural wages. The substitution of machinery for labour then became less profitable. When the outbreak of war did away with unemployment the supply of labour in agriculture fell, relative wages rose rapidly, and should have been met and mitigated by a substitution of machinery for labour.

The war set narrow limits, however, to the machinery available for agriculture. Consequently, relative agricultural wages had to rise sufficiently to keep enough labour on the land to sustain agricultural production at a tolerable level. This in turn determined the prices of agricultural products necessary to pay those wages.

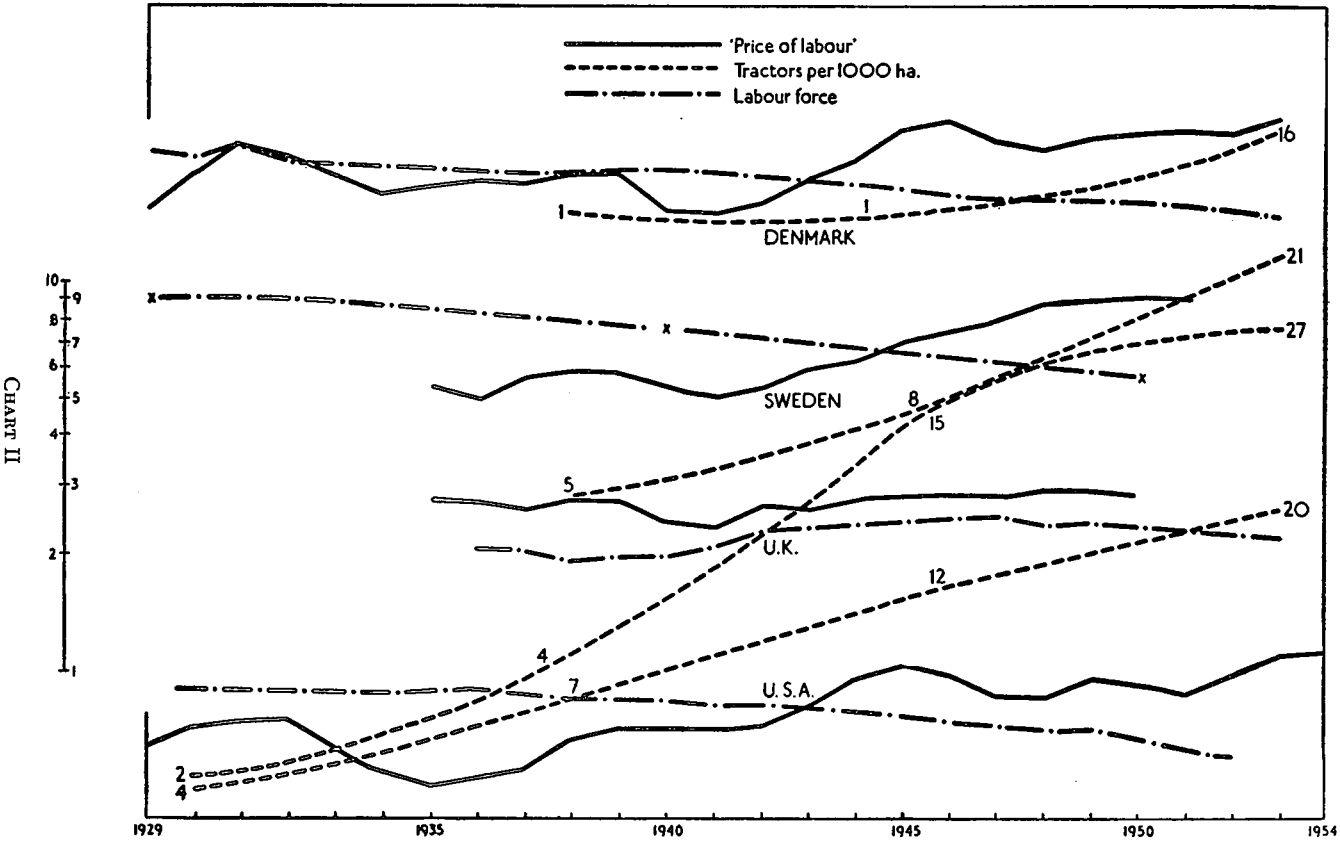
Again Great Britain is a case by itself. As shipping facilities and money to obtain sufficient overseas supplies were deficient, it was necessary not only to prevent an emigration from agriculture, but to cause an increase in the agricultural labour force. Hence, although agricultural labour during the depression years had not experienced the same fall in relative wages as it did in other countries, the rise in relative wages in Great Britain during the war exceeded that of the other countries.

3. When the war ceased it became possible to carry through that substitution of machinery for labour which price relationships for long had made profitable but which so far had been prevented by rationing or blockade. In the U.S.A. where exchange difficulties or lack of productive capacity did not prevent the free purchase of agricultural machinery a great upsurge in mechanization immediately took place. Sweden did not differ greatly from the U.S.A.; in Denmark, however, exchange difficulties prevented the unlimited purchase of tractors until about 1948. It will be seen from Table I that from the time at which mechanization was given free scope the upward pressure on relative agricultural wages ceased, and the trend was even reversed.

The 'Real' Price of Labour

In Table II (pp. 251–2) figures are given for the 'real' price of labour, for the agricultural labour force, and for the number of tractors per 1,000 ha. (serving as an index of mechanization). The course of the figures is pictured in Chart II (p. 255). As figures for numbers of tractors are available only at ten-year intervals the broken lines on the chart represent only a rough graphical interpolation. The same applies to the figures for the labour force in Sweden. The real price of labour

CHART II


'Price of labour'
Tractors per 1000 ha.
Labour force
DENMARK
SWEDEN
U.K.
U.S.A.
1929
1935
1940
1945
1950
1954

(hereafter termed price of labour) is defined as the relationship between money wages and the prices paid to the farmers for their products.

Developments in Denmark and the U.S.A. have been similar:

1. The heavy fall in prices which set in in 1929 led to a proportionate rise in the price of labour. A tendency to reduce the labour force was neutralized by a fall in money wages causing a fall in the price of labour. This trend lasted in Denmark till 1940, and in the U.S.A. till the middle thirties.

2. In consequence the labour force was retained. There was no substitution of machinery, partly because the price of labour was low, partly because the relative price of machinery was high; the relative wages in industry (making the machines) rose.

3. From the upturn of the trend of the price of labour there was an increase in emigration from agriculture. In the U.S.A. there was a considerable substitution of machines, but in Denmark tractors could not be bought until after the war, and not in the desired number until 1948. The rise in the price of labour, therefore, had to be met almost entirely by a reduction in the labour force. Even in the U.S.A. the requirements of the war may have retarded the mechanization process in agriculture somewhat.

4. During the post-war period, with the possible exception of the last two or three years, the price of labour has remained on a high level, and the decrease in the labour force has continued, even accelerating towards the end of the period. Perhaps we can explain this in the following way. In the first post-war years the reduction in the labour force was due primarily to the reduction in supply of labour. Substitution of machinery for labour was not possible to the optimal limit. Therefore, when mechanization was again possible without restrictions, there existed a pent-up possibility of profitable substitution. Towards the end of the period this possibility was exploited, thereby causing a fall in demand, which explains the fall in relative wages found in Chart I as well as the acceleration of the fall in the labour force. It is during this period only, therefore, that mechanization was the dominating factor in the decline of the labour force.

Next let us turn to the development in Sweden and Great Britain. Here I shall call attention to the following peculiarities:

1. The curves representing the price of labour follow a much smoother course, the reason being the greater degree of government interference in agricultural prices and wages.

2. For Great Britain the following points should be noted. Mechanization was speeded up right from the outbreak of the war. This should have made it possible to pay a higher price of labour or

to reduce the labour force drastically. The latter alternative has not been followed. On the contrary, the desire to increase production has called forth an increase in the labour force. In order to achieve this it has been necessary to raise the price of agricultural products so as to stimulate the demand for labour.

A rise in the price of labour signifies a rise in the productivity of labour. This has been achieved in the other countries by substituting machines for labour and dismissing labour. In Great Britain the substitution has been no less but as production has had to be increased the decline in productivity by expanding production has balanced the increase in productivity connected with mechanization. This is the price Great Britain has had to pay for her greater degree of self-sufficiency in agricultural products.

The Demographic Effects of the Structural Change in the Agricultural Population

Great Britain differs from the remaining three countries from which I have drawn my material in the following way. The decline in her agricultural population set in about a century ago, and the agricultural population has gradually been reduced to so small a part of the total population that for many decades it has not been an important source of recruitment for the urban population. Further her situation is unique: while practically all the Western countries have experienced a continual, even an accelerated, exodus from agriculture during and after the war, Great Britain has had to increase her agricultural labour force. Although renewed emigration took place from about 1947, the agricultural labour force is still above the pre-war level. The demographic problem in Great Britain, therefore, has rather been one of re-ruralization than of urbanization.

For two reasons I shall abstain from entering into a discussion of the social and economic consequences of these changes. First because the very small fraction of people occupied in agriculture in Great Britain for many years has been highly urbanized, and second because the decline in the agricultural labour force which set in in 1947 has brought the population structure back almost to the pre-war position, so that there is really no significant change to discuss.

I concentrate my discussion, therefore, on those countries where an exceptionally violent emigration from agriculture has taken place during the last fifteen years. In this respect I think that the three remaining countries with which I have previously dealt are fairly representative. Further, as the problem is essentially the same for all countries, I shall refer only to Denmark and Sweden. Table III

gives figures for the fifteen-year age-group in Denmark and you will see that until 1940 not much less than half of the boys started their careers in agriculture. There were slight changes from year to year, mainly determined by the size of the generation in question. Notice that compared with the numbers born and reared on farms the

TABLE III

Number of 15-year-olds in Denmark
(approximate figures based on census material)

	Male				*Female*			
Year	*Total*	*Of which occupied in agriculture*	*Born and grown up on farms**	*Occupied in other trades*	*Total*	*Of which occupied in agriculture*	*Born and grown up on farms**	*Occupied in other trades*
1901	25,100	12,200	11,500	12,900	About 25,000	10,800	11,000	14,200
1911	27,200	13,600	12,500	13,600	27,000	10,800	11,500	16,200
1921	32,600	14,000	12,500	18,600	32,500	9,500	12,500	23,000
1930	31,800	15,000	11,000	16,800	32,000	10,500	11,000	21,500
1940	32,500	14,000	10,500	18,500	32,500	9,500	10,000	23,000
1950	30,000	8,500	9,000	21,500	30,000	5,500	9,500	24,500
1955	33,000	..	About 10,000	..	33,000	..	About 10,000	..
1960	40,500	..	10,000	..	40,000	..	10,000	..
1965	46,500	..	10,000	..	46,500	..	10,000	..
1970	About 36,000	..	10,000	..	About 36,000	..	10,000	..

* Computed as number of children below 15 in agriculture, multiplied by number of 15-year-olds in agriculture, divided by number of children below 15 in agricultural districts.

entrance of young people into agriculture was especially great in the period 1930 to 1940, signifying again that heavy unemployment outside agriculture forced the young generation in the agricultural districts, but not born on farms, to seek employment on the land in greater numbers.

Between 1940 and 1950 a marked change in the number entering agriculture took place. Most of the single years of the decade could be filled in by available statistics. The detailed figures show a gradual change from 1941, but as late as 1945 the number of entrants was 10,500. It reached 8,100 in 1949 and has kept about stable since then.

The second section of the Table gives the same figures for females. It will be noted that a smaller proportion of females during the whole period started their careers in agriculture, and also that the changes taking place during the war were much more violent.

These figures could be analysed from two points of view: (1) the structure of the agricultural labour force and the future supply of labour in agriculture, (2) the effect on the economic and social

structure of the population in general, including the degree of urbanization.

TABLE IVa

'Survival' Table for Male Agricultural Personnel in Denmark
(approximate figures)

Year / Age	1901	1911	1921	1930	1940	1950
17 years (born in agriculture) .	11,500	12,500	12,500	11,000	10,500	9,000
17 years . .	12,200	13,600	14,000	15,000	14,000	8,500
27 years . .	6,200	6,900	7,400	8,700	8,800	6,200
37 years . .	5,800	5,800	6,300	6,600	7,800	6,800
47 years . .	5,100	4,800	5,600	5,600	6,100	6,800
57 years . .	3,600	4,100	4,100	4,600	4,500	6,500

Turning to (1) it is clear that an increase in the average age of the agricultural population must occur because the young generation entering the trade has been declining strongly since 1942 and also because the older age-groups belong to considerably larger generations of entrants.

This change in the age structure must be taken into consideration, if we want to calculate the changes in labour input. There can be no doubt that calculated on a quality basis the reduction in labour input has not been nearly so great as the reduction in the numbers employed. Calculated by dividing the total wage bill by the wage of a standard unit of labour, the reduction of labour input in Denmark since 1939 seems to have been about 13 per cent.,[1] whereas it has been about 25 per cent. if measured by the numbers employed. This should be borne in mind when calculating changes in labour productivity in agriculture.

The effect on the future supply of labour in agriculture could perhaps best be studied on the basis of what you might call a 'mortality table' of agricultural personnel, showing how a generation entering the trade diminishes through time by transition to other trades, by deaths, or by retirement. Such figures are given in Table IV (*a*)

[1] As calculated by Holger Gad in an unpublished work.

and (*b*) respectively for men and women in agriculture at the age of seventeen.

Let us follow the last generation which was affected neither by the depression of the thirties nor by the reduction in the number of entrants which took place after 1940, namely those who were seventeen years old in 1911, and who were forty-seven in 1940. During that period the loss by death and retirement was almost negligible. The diminishing number in the sloping column, therefore, is due almost entirely to transition to other occupations. It represents a fairly normal pattern of the structure of survival of agricultural personnel until the new development set in during the war.

The age-group of forty-seven years, or for that matter thirty-seven years, represents the number in a generation that may be expected permanently to stay in agriculture. In the period spoken of it seems to have been about half of the original entrants. The main departure to other trades took place between the ages of seventeen and twenty-seven and seemed to be about 45 per cent.

The annual number needed to replace the loss of farm managers by death and retirement is a little more than 6,000. They have in the main to be recruited out of the stream of entrants remaining in agriculture, which can be fairly well measured by the size of the twenty-seven-year age-group. The individuals of that group who are not qualified or willing to become managers of farms leave agriculture or stay on as permanent day-labourers. Turning next to the seventeen-year group of 1940, which is 14,000, we find that ten years later it was reduced to 6,200, a figure almost equal to the number needed to replace deaths and retirements of managers, if the age-structure of this group is to be maintained. Now it is evident that not all of those 6,200 are qualified as managers and, in addition, it is not likely that they are willing to stay on in agriculture permanently. Further it is evident that the number is not sufficient to sustain the present labour force in agriculture which requires the replacement of perhaps another 1,500 as functionaries and permanent labourers. In 1950 the seventeen-year age-group was only 8,500 and has kept fairly constant until now. Assuming an average actual period in agriculture of about forty-two years, those 8,500, if they all stayed in agriculture, would be about sufficient to maintain the present labour force in agriculture. This, however, is an altogether unreasonable assumption.

We have seen that the 14,000 seventeen-year generation of 1940 was reduced in ten years to 6,200. Although the same rate of departure from the seventeenth to the twenty-seventh year could not be

expected with the 8,500 entrants of 1950, it is hardly reasonable to assume that even as many as 6,200 of the 1950 entrants would still be in agriculture ten years later.

What are the consequences?

Alternative 1. Suppose that under present employment conditions inside and outside agriculture 5,500 of the 8,500 entrants of 1950 remain in agriculture after the lapse of ten years and that 80 per cent. of those, i.e. 4,400, are qualified as farm managers under present farming conditions. That number would be sufficient to maintain about 140,000 farms. As at present we have about 185,000, a considerable aggregation of farms would have to take place. We should have a total male labour force in agriculture consisting of about 70,000 below twenty-seven years and 176,000 twenty-seven years and over, adding up to 246,000, of which 140,000 would be managers and 106,000 labourers, as against a total male labour force of about 300,000 today. That would mean not only a revolutionary change in the social situation in the countryside but a great, although not nearly proportional, reduction in total net agricultural production.

Alternative 2. Assume as another extreme that the labour force in agriculture is not to be allowed to fall further because the political authorities think that agricultural production should be maintained. This goal could certainly not be realized without a relatively great rise in agricultural wages. We know this from the fact that at present relative wages, which in the countries here dealt with (except Great Britain) have been slightly falling in recent years, the exodus of labour has accelerated.

Owing to the very small annual recruitment into agriculture in recent years the labour force initially could be maintained only through attracting labour from other occupations. Even a considerable number of farm managers would have to be recruited from the towns. This re-ruralization would probably require a very large rise in relative wages and correspondingly high prices of agricultural products. However, in so far as the relatively better working conditions attract a greater number of youngsters into agriculture, an equilibrium may be attained at a somewhat lower relative wage than would prevail during the transition period. This is because it will not be necessary to recruit labour from other occupations to the same extent.

There are many intermediate alternatives, of course, and those adopted will differ between countries. In the U.S.A. the first alternative would solve the surplus problem and presumably would not

cause serious difficulties, except of a purely political nature. In fact, it seems to be difficult to solve the surplus problem in any other way. In the importing countries of Europe the second alternative could be attained by increasing subsidies or other forms of agricultural protection. In some of the importing countries equilibrium could be reached without great sacrifice in terms of production by eliminating a number of very small holdings and by a redistribution of land so as to abolish the strip farming prevailing in certain areas.

In Denmark there is a strong political sentiment in favour of maintaining smallholdings and even of subdividing land by means of subsidies. Furthermore it may be doubted whether the decline in agricultural exports which would follow from a fall in production could profitably be substituted by increased industrial exports. The chances are, therefore, that the second alternative will in the main be followed. A relative rise in agricultural prices and wages would have to take place in order to make this possible. The rise in prices could be moderated, however, if some aggregation of farms were allowed. This would raise labour productivity, because modern machinery could be more effectively applied. The political sentiment in favour of smallholdings may, however, prevent even a moderate change in this direction, although the real cost of such a rigid preservation of smallholdings will be rather heavy.

In Sweden there is an attempt to solve the problem by gradually eliminating marginal farms and by raising the marginal productivity of labour correspondingly, but production will hardly be allowed to drop below the level sufficient for self-sufficiency in agricultural products, at least as far as animal products are concerned.

The essence of the situation is that in all countries the situation is one of extreme disequilibrium, and that as the processes at work consume much time the final results of the processes are not fully grasped by the parties concerned. Action is delayed, therefore, and things may turn out quite differently from what is desired and expected. This again may lead to excessively drastic action causing new and undesirable repercussions.

I shall not make many comments on Table IV (*b*). About 6,000 women of thirty-seven years of age seem to be necessary to supply the farmers and farming personnel with housewives. Formerly they were recruited by an entrance at the age of seventeen of about 10,000. But in 1950 the number entering was reduced to 5,000. As a considerable number of them are bound to leave agriculture for good, the conclusion is that the farmers and farm labourers will have to recruit their wives from the towns more and more if the present

numbers of farmers and farm workers of mature age are to be maintained.

There can hardly be any doubt of the great effect this will have in changing the whole atmosphere of the farm. Neither is there any

TABLE IVb

'Survival' Table for Female Agricultural Personnel in Denmark
(approximate figures)

Year / Age	*1901*	*1911*	*1921*	*1930*	*1940*	*1950*
17 years (born in agriculture) .	11,000	11,500	12,500	11,000	10,000	9,500
17 years . .		10,000	10,000	11,000	9,500	5,000
27 years . .		6,000	7,000	7,000	6,500	5,500
37 years . .		5,500	6,000	6,000	6,500	6,000
47 years . .					4,000	5,000
57 years . .						

doubt that this urbanization of the farm cannot prevail unless either prices of agricultural products rise, or the marginal productivity of labour is increased e.g. by improved technique.

In Table V I give related figures for Sweden where development is very similar to the Danish, though emigration of labour from agriculture seems to have started at an earlier date. There seems to have been a shortage of women of mature age in agriculture for many years, and increasingly so during the last couple of decades.

There is a difference between Denmark and Sweden that in Sweden there is a tendency to seek a solution in reducing the number of farms whereas in Denmark the Government is still subsidizing the subdivision of land into smallholdings.

Changes in the Economic and Social Structure

Returning to Table III we see that until 1940 about half of a generation of males started its occupational career in agriculture, whereas for women the corresponding figure was about one-third. During the last fifteen years this fraction has continuously declined. For men it is less than one-fourth and for women it is one-sixth.

TABLE V

Agricultural Personnel in Sweden
(approximate figures based on census material)

	Male						*Female*					
Age	*17 years*			*22 years*	*27 years*	*47 years*	*17 years*			*22 years*	*27 years*	*47 years*
Year	*Total*†	*Of which occupied in agriculture*‡	*Born on farms*‡	*Occupied in agriculture*‡			*Total*†	*Of which occupied in agriculture*‡	*Born on farms*‡	*Occupied* in *agriculture*‡		
1910	55,000	20,000	25,000	20,000	13,000*		53,000	15,000	24,000	15,000	12,000*	
1930	50,000	20,000	25,000	21,000	17,000	12,000	47,000	18,500	19,000	14,000	13,000	11,000
1940	41,000	20,500	15,500	18,000	16,000	13,000	40,000	14,000	15,000	11,000	11,200	11,600
1945	45,000	15,000	15,000	15,000	13,000	13,000	44,000	10,000	14,000	9,000	9,500	11,500
1950	52,000	11,000	13,000	9,500	9,700	12,500	50,000	7,000	12,000	6,200	7,600	10,000

* 38 years old. Computed as the number between 27 and 47 years divided by 20.
† Computed as the number of children below 15 years divided by 16 in order roughly to account for deaths.
‡ Computed as 5-year age-groups divided by 5.

This has two very important effects. Other trades have to expand to absorb not only the increasing population as they have for many years, but also the labour set free from agriculture. In addition the educational and mental background of the people will be changed. The town population and the town mentality will become more and more dominant not only with regard to the people engaged in the town occupations but also among the people that agriculture must acquire from the towns. An urbanization of the agricultural population will develop with far-reaching economic, political, and cultural consequences.

D. K. BRITTON, *Food and Agriculture Organization, Geneva*

I hope Professor Pedersen will forgive me if I refer to only two points arising from his very interesting paper, and then go on to add some general comments on the broader aspects of the subject to which this session is to be devoted.

First, I should like to say that the position of the United Kingdom in recent years does not entirely correspond to the description which Professor Pedersen has given us.

It is true that the labour force in agriculture increased during the war and continued to increase until 1947 or 1948; but thereafter there has been a continuous decline, not much less rapid than has been observed in the other countries which Professor Pedersen has cited. The rate of decline in the numbers of workers on agricultural holdings (excluding farmers and their wives) is now between 2 and 3 per cent. per annum. It is evident that the increase during the war was a temporary deviation from the long term downward trend to which we had become accustomed before the war, and that the pre-war pattern has now reasserted itself.

My second point concerns Professor Pedersen's remarks about the present shortage of young recruits to agriculture in Denmark. He points out that the numbers coming forward each year are insufficient to maintain the present number of farms, and suggests that either incomes and wages in agriculture will have to be raised in order to attract more young people from industry or other occupations, or else the present number of farms will have to be reduced. I should like to suggest that if Denmark is really short of farmers there may be a third alternative which Professor Pedersen has not considered in his paper, namely the possibility of receiving immigrant settlers to occupy the farms which appear to be falling vacant. I should be glad to hear the comments of our Scandinavian friends

on this possibility, especially in view of the objections mentioned by Professor Pedersen to the other two alternatives.

The fact of decline in the agricultural labour force is not in itself a matter which, generally speaking, need cause great concern. When economists call for a proper balance between agriculture and the rest of the economy, they can hardly mean that the relative numbers in each should remain at a certain level. This condition would characterize not a stable but a stagnant economy. Mankind as a whole has only a certain number of working hours available in a year, and the fewer the hours which have to be devoted to the provision for basic needs —food, clothing, and housing—the more are left over for the enrichment of the quality of life, both material and mental. Nor should we overlook the possibility that food may be provided by new methods of synthesis which would require no agricultural activity—a prospect which we may regard as exciting or unexciting according to whether our preoccupations are mainly agronomic or gastronomic.

But the *rate* and *incidence* of decline in different social and agricultural situations are certainly important matters. The lack of sufficient incentive or opportunity for workers to move out of agriculture is often a symptom of maladjustment in the economy, and often the transfer does not take place without considerable hardship. We need to do all we can to ensure that the necessary changes are made in an orderly way and with the minimum of social upheaval.

In parts of western Europe we face a situation which resembles the familiar problem of an irresistible force meeting an immovable object. The irresistible force in this case is the trend towards mechanization and other technical improvements with which this Conference is especially concerned; the immovable object is the existing structure of holdings which, as a number of speakers have already remarked, is usually very difficult to change. The situation has been put before us in its most acute form in Professor Pedersen's paper. We in the F.A.O./E.C.E. Secretariat at Geneva have tried to describe the same problem and some of its implications for policy, in a publication of 1954 entitled *European Agriculture: a Statement of Problems*.

I should perhaps explain in passing that in opening this discussion I am not acting as an official spokesman for F.A.O. I have come as an observer to find out the present currents of thought in this field, and am only giving you some personal comments. I should also add that in my work I am concerned only with European agriculture, and much of what I have to say may not apply, except indirectly, to other parts of the world.

What is our duty as agricultural economists in face of the problem which is now under discussion? It is, I suggest, the same as our duty in face of all other agricultural problems which confront us: to describe and diagnose the condition as clearly as we can; and to propose ways in which it can be remedied with the minimum of interference with human welfare and human desires. It is, to use your own phrase, Mr. President, a question of engineering a social change.

For the description and diagnosis we need precision instruments. Some of you already know that I have a firm belief in the statistical approach to problems of this kind. I know that there are those who are sceptical of the value of statistics as an aid to tackling this social problem. We know the conditions well enough, they say. These conditions have been with us for generations and are all too familiar. Yet I still think that the statistical approach can be of service.

Consider the clinical thermometer. This is a precision instrument, an ingenious invention delicately manufactured and carefully graduated. The doctor comes to the bedside of a sick child, takes his temperature, and solemnly announces that he has a fever. For the child's mother this is not a new discovery; she has already found out as much by a touch of the hand. But the thermometer is a graduated instrument by means of which the doctor can tell whether the condition is critical or only more or less normal; and by taking repeated observations he can tell whether the illness is following a normal course or whether there are abnormal symptoms.

What precision instruments can we use? Here we in F.A.O. feel ourselves greatly handicapped by an inadequacy of the resources which have been directed to this field—to which inadequacy Dr. Sherman Johnson has already referred. In fact we have very little beyond census material with which to study the employment situation. I cannot now enumerate all the inadequacies of census data dealing with agricultural labour; they are well known to most of you. I will mention only their infrequency of collection—an interval of ten years is less than the 'time-span of significant change' in our modern world; the inadequacy of the usual classification to take account of part-time or secondary occupations (of both men and women) or to provide a measure of the *duration* of work in agriculture by the persons concerned, in the course of a year; and the mistakes or misrepresentations committed by the respondents when completing the questionnaires. Nevertheless I am sure that much more can be done with the national census statistics, especially by analysts of the countries concerned who know these problems intimately, than has evidently been done up to now.

By way of illustration I should like to describe briefly results of some work which has been done by one of my colleagues, Mr. F. Dovring. He has investigated the surpluses of labour in agriculture in certain countries; surpluses, that is, which are apparent if the existing labour force is measured against reasonable labour requirements by reference to what could be achieved on normally efficient farms. The existence of under-employment in agriculture is already a well recognized fact. For example, in Italy it has been estimated that the labour surplus amounts to not less than two-thirds of the agricultural labour force. Again, in Greece, an investigation has reached the conclusion that only about 40 per cent. of the agricultural labour force is really occupied.

Mr. Dovring's work—some of which has already been published in *Agrarwirtschaft*—shows clearly that the surplus tends to be concentrated almost entirely on the smaller farms. He finds that once the farm has reached a size which is sufficient to give full employment to two man-units, the existence of surplus labour is much less frequently to be observed than is the case with smaller farms. In the countries which he has studied, this critical point of two man-units seems to coincide with a size of farm somewhere between 10 and 20 ha. The important point to note here is that the nature of this surplus would remain concealed if the analysis were not carried out on a size-group basis.

Similar results have been achieved by Maris in the Netherlands and by Baptist and Waterschoot in Belgium. But it is necessary to examine the dynamic situation as well as to take a still photograph at one moment in time. The doctor takes the child's temperature day by day throughout the illness. Much more valuable than the analysis of a single census is comparison of the trends between two dates. Only then do answers begin to emerge to some important secondary questions. Where is a decline in labour taking place? What categories of labour are disappearing most rapidly? From what size of farms are they going and what patterns of employment groups are undergoing change? Some work of this kind is going on, but we should like to hear of much more of it. For it would enable us to come much more quickly than is now possible to the next stage, which we might think of as a bridge between diagnosis and prescription.

As we approach the heart of the matter the statistical method fails us and we must have recourse to close and patient case-studies. Statistical analysis can help to ensure that our questions are put to the right sort of people, in the critical situations; but the questions have still to be put. As we identify the growing points or points of

obsolescence I believe that we shall be driven to distinguish a number of type-situations. For example, that of the farm whose labour force consists of: the farmer, now nearing the age when he might fairly expect to retire from active participation in the physical work; his wife, who looks after a few poultry; and two sons, one of whom is on the point of moving to a job in the town and who will not return. What is the 'impact of technical change' in regard to the possibility of carrying on that farm? What are the prospects for income per head in that family? And what in fact is taking place today on farms in that situation? Or take again the case of the remote mountain farm where the sons have already left and only the elderly occupier and a daughter remain. The farm is on the decline. For how many years will the situation continue? And what happens when the farmer dies? Have we to devise ways of easing that situation in such a way that the 'death' of the farm as a separate entity can be made something not altogether intolerable to the remaining members of the family?

There is no time now to deal with the stage of prescription—when the clinical thermometer can be put away and the cure can begin. Let me conclude by restating my conviction that the 'engineering of social change' in agriculture is the central problem for agricultural economists living in an expanding economy. Adjustments of the employment structure will always be needed, whether we are moving towards freer international trade or towards a system of closed national economies, whether we enter a phase of 're-ruralization' or proceed still further with urban development. The process of adjustment will have to go on year by year, much in the same way as a tree has to be pruned if the growth is to be healthy and productive.

The solutions to the problem which Dr. Pedersen has described seem to lie somewhere in the borderland of economics, sociology, and psychology. There will be important questions concerning auxiliary employment for those already working on farms and vocational guidance for rural children about to leave school. In the rapidly changing situation the utmost flexibility of attitudes will be needed, and the voice of tradition is unlikely to receive a very respectful hearing. We have striking evidence that at the present time not only are sons unwilling to continue the methods of farming to which their fathers have been accustomed, but also that fathers are adopting new and improved farming practices under pressure from their sons.

Mr. President, in your opening address you reminded us that the Conference has a constitutional obligation to concern itself with problems of rural life. F.A.O. shares that same constitutional obligation and, along with I.L.O., shares that same concern. But we need

to increase and deepen our knowledge of the facts of the situation. May I therefore urge those who are studying these problems in the various countries represented here, continually to make known their requirements in labour statistics to those who plan national census inquiries, and to see that all the relevant analyses are fully and promptly carried out—not to provide playthings for statisticians but as necessities for relieving difficult human situations. And then, armed with the statistical data, send your research teams to find out what is actually happening at the points of crucial change. And then let us pool our experience and compare our results one with another.

KAZUSHI OHKAWA. *Hitotsubashi University, Kunitachi, Tokyo, Japan*

I would like to stress the importance of industrialization as a necessary but not sufficient condition of technical progress in agriculture. Professor Pedersen has presented a very illuminating analysis of the changes in the agricultural labour force in most developed countries in these last fifteen years. In the first part of his paper he finds the basic cause in the factor-price relationship between labour and machinery, and rejects the explanation that it is mainly due to the mechanization of agriculture. Only in the last few years does he find mechanization as a principal cause of the decline of demand for labour in agriculture. I have no exact means of judging such experiences in most developed countries, but it seems to me that his analysis is reasonable in general. However, taking into consideration the experiences of Japan and the problems with which she is now confronted, I would like to examine the question from a somewhat different aspect.

Dr. Brandão stressed the important effect of industrialization upon technical progress in agriculture when he discussed Dr. Johnson's paper, and Professor Halcrow has presented the concept of a balanced development between the agricultural and non-agricultural sectors of the economy. At the same time Professor Schultz pointed out the necessity of dynamic treatment of our subject. These ideas impress me very much. In this context, I would like to indicate the principal factors which affect the employment situation in agriculture during a period of general economic development, adopting the terms of 'growth-rate' or 'increasing-rate' from modern macro-economics.

I assume two sectors of the economy, one the agricultural, the other the non-agricultural. And I consider two equations, one concerning supply-demand relationships for agricultural output, and the other concerning supply-demand relationship for the labour force in

agriculture. On the demand side of output we have first the income elasticity of demand; next, the growth-rate, or increasing-rate, of *per caput* real income; and lastly, the growth-rate of population. On the supply side of output comes the growth-rate of labour productivity of the agricultural labour force. Next, apart from this output relationship, we must consider the supply-demand relationship of the labour force. The growth-rate of demand for labour is given by the growth-rate of the non-agricultural sector; and the supply of labour is, of course, determined by the growth-rate of the labour force in agriculture. These three variables concerning output and two variables concerning the labour force comprise, I think, the main factors which affect the employment situation in agriculture. We can assume that the equilibrium process of growth arises through the interplay of these five factors. Equilibrium process of growth may be defined here as a process in which price relationships remain constant; or, as a process in which the demand curves and supply curves for output and labour respectively exhibit the same rate of shift. Of course we can express these relationships easily by simple mathematical formulae but I do not think it is necessary to do so here.

In the case of Japan and other densely populated, less fully developed nations of the world, the output relationship is apt to be in the over-demand condition, in contrast with the over-supply condition in well-developed countries, and yet under-employment prevails widely in the agricultural sector. By under-employment in agriculture I mean that the marginal productivity of labour is less than it is in the non-agricultural sector of the economy. This of course means an over-supply condition in the labour force in agriculture, in contrast with the sharply declining tendency of the agricultural labour force in well-developed countries as Professor Pedersen has mentioned.

Output deficit, and under-employment in agriculture, must be eliminated so far as possible for the sake of national efficiency and welfare. What role has technical progress in agriculture in the solution of this problem? That is our question. Because time is short I will confine my discussion mainly to labour supply and demand relationships. I define technical progress to mean the introduction of labour-saving technique which raises output per man, or more strictly per working hour. Mechanization of agriculture, as Professor Pedersen has pointed out, is, of course, the most notable case of labour-saving innovation. But other types of technical progress—for example, better fertilizers, better livestock, better seed, better

insecticides—are also labour saving. Professor Pedersen pointed out that the decline in the agricultural labour force has taken place despite an increase in total agricultural output in well-developed countries. Even in Japanese agriculture where under-employment is a troublesome fact, the number of occupied people has been declining slightly since about 1880 with the exception of the period immediately after World War II. I must mention here that the growth-rate of the Japanese economy during these sixty years was very high in comparison with that of most Western countries. From the take-off period of modern capitalism down to the period immediately before World War II, agricultural output increased roughly three times. Labour productivity thus increased slightly more than this.

In this context, I would like to say something about the popular idea of technical progress in Japanese agriculture. It is said that in Japanese farming the emphasis is upon maximizing yield per unit of land by substituting capital and labour for land as far as possible. This is true of the individual farmer. But historical observation of the whole agricultural industry reveals that labour-saving techniques have been introduced to a considerable extent through capital investment, private and governmental, in both physical and monetary forms.

In order to introduce more labour-saving techniques, the degree of under-employment must be reduced. Professor Pedersen's data on relative wages in agriculture and unemployment in the industrial sector support this view. The negative correlation between the two sets of figures presented by Professor Pedersen shows that the relative wage of agricultural labour is high when the economy is growing rapidly. Japanese data also clearly show a similar process. In the depressed early 1930's the wage of male agricultural workers dropped to about 38 per cent. of the industrial wage—as against some 65 per cent. in the more prosperous 1920's. A rise in relative agricultural wages took place in the latter part of the 1930's; and during the period of World War II it went as high as a little over 100 per cent. We must be careful in interpreting these figures, as Mr. Mackenzie pointed out the other day. In addition, as regards Japanese agriculture, there is little hired labour because of the predominance of the family farm. But the change of wage-rate expresses, and is the index of, the change in evaluation by farmers of their own labour on the farm. It is with this meaning that I use these figures. Now returning to the point, after the war the relative wage dropped again to the lowest level of the 1930's.

According to Professor Pedersen's paper, mechanization of agri-

culture was checked by the low real price of labour and accelerated by its higher price. I believe that this is the mechanism by which labour-saving innovations are introduced in the private enterprise economy. In these fifteen years in Western countries such as Denmark, Sweden, and the United States there certainly has been a high rate of transfer of labour from the agricultural to the non-agricultural sector of the economy. It follows that the introduction of labour-saving techniques can take place without causing further unemployment problems, disguised or otherwise, only when the surplus labour is entirely absorbed by the non-agricultural sector. This condition is, I think, the most important factor for increasing agricultural productivity in Japanese agriculture now. I believe it may be true also in the agriculture of similar countries.

S. HOLMSTRÖM, *Jordbrukets Utredningsinstitut, Stockholm, Sweden*

It is interesting that the title in the programme is 'The impact of technical change on the employment situation', &c., when Professor Pedersen has shown that the influence has mainly gone in the opposite direction. He says that people generally explain the considerable decline in the agricultural labour force as being due to the fact that mechanization renders a great part of the former labour force unnecessary. I cannot quite agree with that. In any case opinion in Sweden holds that it is probably scarcity of labour which has forced farmers to mechanize. However, that is not the only reason. So far as Sweden is concerned, the price indices for different factors of production can tell us something about what must also have been an important inducement for mechanization on farms with skilful managers. Taking 1939 as the base year we get the following price-index figures: farm labour, 485; tractors, 190; all machinery, 200; fertilizers, 190. Before the war a farmer could pay for about 4 labour hours with the same amount of money as he had to spend for 1 tractor hour. Today only a little more than 1 labour hour is equivalent to 1 tractor hour. Under these conditions it is quite clear that mechanization in many cases—especially on large farms with skilful management—has come first. An interaction has occurred between two tendencies: (1) decreased supply of manpower in agriculture has demanded mechanization; (2) mechanization forced by the increase in wages has diminished the demand for manpower in agriculture and caused a transfer to other occupations. I think that more consideration of the relative changes in costs would have contributed to the analysis of the remarkable change in farm population in recent years. In Sweden farm population has decreased by at least 35 per

cent. since 1939. Professor Pedersen stated: 'There can be no question, therefore, that the fall in relative wages in recent years has been due to a reduction in demand.' I am not quite sure that this is true. With regard to Sweden, the fall in relative wages is a result of more complicated factors tangled up with stabilization agreements, price negotiations, and so on. In recent years, at almost all times, there has been a strong demand for labour both in farming and industry.

The methods used in the analyses are very interesting indeed, but I believe it would have been worth while to study the basic figures more critically. For instance, the number of tractors could be obtained for every year—at least, in Sweden. Ten-year intervals should not be used for a period with such great changes. The figures for the labour force could have been checked by means of representative figures for yearly movements of population from the land to towns. There are also in Sweden figures from a census of 1945. Also, the tractor index is a very rough expression of mechanization, as Professor Pedersen has emphasized. I do not think that index is quite comparable for the different countries because of the uneven distribution of tractors. Furthermore, population statistics do not give precise information on the labour force in agriculture, because some people living on farms and working in other occupations are probably mixed up with the real farm population. This fact was also mentioned by Mr. Britton.

Lastly, Professor Pedersen said, 'Let us assume as another extreme that the labour force in agriculture is not to be allowed to fall further because the political authorities think that agricultural production should be maintained.' Here I will put a question to my Danish friends. If you neglect what political authorities are thinking about that question—and of course you should do so—what do you economists think as to the possibilities of maintaining production in Denmark with a decreased farm population? Personally I think that Sweden cannot do so, but that Denmark can. That is because in Sweden farms are often so scattered that they cannot be combined. Instead, they will be transformed into forest land. In Denmark, on the other hand, it would be possible in almost every case to combine farms so as to decrease farm population without any substantial decrease in production.

G. P. Wibberley, *Wye College, University of London*

May I try to tell you a short fairy story? Once upon a time there was a country which had managed to get into the position of having only 7 per cent. of its employed population working in agriculture.

Many people in this country were very pleased with this and believed that they had a developed country. As many millions of people shivered in their houses each winter in front of wasteful open coal fires, it would be more accurate to use Dr. Aziz's phrase and call the country 'mal-developed'.

The reduction in the numbers engaged in their agriculture has also not proved to be all gain. The agricultural population is so few and thinly scattered that farmers and workers with their families make up, on average, fewer than one hundred persons per square mile. These farming people, in their so-called civilized country, naturally want the same amenities and services as their urban cousins, but with this thin scatter they cannot possibly support them on their own numbers alone. For example, there should be at least 600 people in a rural community to justify the provision of only a few of the things these people demand, such as a village shop, a church, a social institution called the 'pub', and a village school with enough pupils in it to provide two teams for a game thought to be extremely important and which is called cricket.

In a countryside in such a position, it is obvious that the farm people rely heavily on other groups in the rural population to give sufficient numbers and income for the support of their community services. In the prosperous farming areas of that country the pattern of the rural population is of this order—40 per cent. directly concerned with food production, 35 per cent. working in and supported by service and secondary industries, and 25 per cent. living there solely by reason of choice and not because of the location of their jobs. This pattern gives at least 250 persons per square mile of countryside—a much better support for the provision of civilized institutions than the agricultural population could manage on its own.

This average hides other more local problems. Technical change in agriculture has created many jobs in service industries. Yet this service population is very small in the non-arable areas which concentrate on livestock production. Here also are few people living by reason of choice. The total population is therefore made up mainly of farming families and they can offer only about 50 or fewer persons per square mile to support community institutions. Again, technical agricultural changes have been associated with a movement of servicing occupations out from local hamlets and villages to the country towns and cities. These service people do not therefore reside locally and care little about the cry of the farming population for local amenities.

The mobility of rural people in this mal-developed country is very

great but has unfortunate variations. Most farmers run their own private cars. This gives mobility to their whole families. The farm worker, on the other hand, has achieved in most areas only mobility for himself—a cycle or motor-cycle. His family are dependent on public transport and the availability of this is again related to the total number of persons in the countryside.

These and other weaknesses emphasize the needs of this type of country for geographically mixed areas of agriculture and industry and for high agricultural incomes and wages in the isolated areas, so that farming people can provide their own means of physical mobility.

I have tried to tell you this story because many speakers at this Conference have praised reductions in the number of persons employed in agriculture as though all the results were beneficial. May I close by saying that any similarities between this mythical country and one which many of you know are purely intentional.

V. M. JAKHADE, *Reserve Bank of India, Bombay, India*

Certain basic factors must be taken into account in formulating agricultural and employment policies in countries which are mainly agricultural and where population presses heavily on land. Developments in the Indian economy over the past few decades bring out three main features. First, progress has been confined to industry, transport, banking, &c.; agriculture has been stagnant from the point of view of the techniques of cultivation. Secondly, despite progress in the non-agricultural sector, the occupational structure has remained predominantly agricultural. Thirdly, high population increase and limited land resources have given rise to a vicious circle of low incomes and low investment in agriculture. In this situation it is inevitable that the propensity to adopt labour-saving and capital-intensive methods of production is somewhat low, because the motive forces of rapidly expanding markets and relative shortage of labour are not at present operative. A large number of farmers are smallholders who are employed on their farms for some months only. The demand for labour is highly seasonal and there is considerable unemployment and under-employment in rural areas. Industrial progress has had very little effect so far on agricultural employment.

The effect of mechanization will be to reduce the labour input per unit of output and bring down labour requirements during the peak seasons. It will also mean a fall in the total number of work-days required for operations on the farm. It follows that unless there is a major extension of area under agriculture and of demand for agricultural products, mechanization will reduce agricultural employment.

Such a displacement would not constitute a problem—indeed it would be beneficial—if at the same time there was an increase in employment opportunities provided by the industries manufacturing and servicing the machines. If, as in India, an increase in the use of highly mechanized equipment is possible only through imports, or if the magnitude of the displaced labour force is very large, such an adjustment will not take place, and the resulting unemployment may not be transitional only.

It is possible, of course, to argue that mechanization will contribute to a reduction in prices in a variety of fields and set in motion the processes of continued expansion of markets and division of labour so necessary for economic development. But this is a process which, by its very nature, has to be cumulative in order to be effective. That is to say, the substitution of machines for men in agriculture should, through an increased demand for the machines, lead ultimately to an increase in the output of all those industries contributing to the production of the machines. By thus creating new jobs for persons displaced from agriculture, the demand for agricultural products should be augmented also. Mechanization of agriculture has, therefore, to be part and parcel of a programme of widespread industrialization, which in its turn implies a big increase in the community's investment effort. At this point the well-known circle appears: investment can be effectively stepped up only if labour productivity increases all round, and labour productivity will rise all round only if the rate of investment goes up. With limited resources for investment, the process of breaking this circle has to start with concentration of available investible resources in particular fields, the development of which will not only make possible investment in a variety of new industries and trades, but also strengthen the multiplier effect of investment in existing industries. Theoretically, this may be achieved by large-scale investment in mechanization of agriculture, if there is reasonable ground for presuming that the required agricultural machinery can be produced domestically. But in India at any rate there is no basis for such an assumption at present. Besides this, there are many other factors such as size of holdings and tenure systems, which have to be taken into account. Weighing all these factors together, it may be said that the scope of mechanization is limited, at least in the proximate future.

In the meanwhile, the increase in productivity will have to be brought about by less spectacular but sufficiently effective means, such as by more irrigation and fertilizers, and better seeds. But such development will result in a reduction of under-employment rather

than in a net increase in the number of persons employed. Even if there is an increase in numbers employed, it will very likely be insufficient to provide full employment for all those who are added annually to the rural labour force. In such a situation, the main influence on the occupation pattern will have to come from a rapid increase in employment opportunities provided in the non-agricultural sectors and a shift to those sectors of the annual additions to the total labour force. It is only after this process gathers momentum that one may expect a reduction in the number and proportion of those seeking their livelihood in the rural sector.

O. GULBRANDSEN, *Industriens Utredningsinstitut, Stockholm*

Professor Pedersen called attention to the fact that the persons who leave agriculture are mostly young so that the remaining labour force grows older. But in Sweden at any rate these young persons also make up the bulk of those employed in agriculture. In the last fifteen years numbers employed in agriculture have decreased by more than a half while the numbers of farm managers have fallen only about 10 per cent. This means that in the 1930's, on average, one worker was employed per farmer, while today there is only one worker for every two farmers. This has created one of the greatest of present-day problems in Swedish agriculture.

Of the 300,000 farms in Sweden 100,000 are too small—that is to say, they have less than the 10 ha. of cropland which the Government has accepted as the minimum area for a complete farm. On these smallholdings we find the bulk of old farmers. Sixty per cent. of these smallholders are more than fifty years old, compared with 45 per cent. of the larger farmers.

How can we solve this problem? The decrease in labour force is not our most awkward problem, because there is a very rapid increase in labour productivity. Our main task is to ensure that the outflow of labour reduces the number of undersized holdings, while maintaining sufficient workers on the efficient farms. The effect of the State programme, which now 'rationalizes' about 1,300 farms per year, is claimed to depend upon economic forces. But economic forces of themselves drive out five times as many smallholdings each year. One of these economic forces is the low income from smallholdings, which causes a very low recruitment of smallholders. The reduction in the number of smallholdings will therefore depend on the death and retirement of the older smallholders. In a forecasting calculation of my own I have found that this factor may reduce the

number of all farms by more than one-third in a period of twenty years.

There has also been another significant economic force during late years. A large number of smallholders work part-time in non-agricultural jobs, especially in forestry. After the war the demand for labour has been high even in rural areas and the transportation facilities, especially motor-cars and motor-cycles, have increased in an explosion-like manner. These factors have pulled many part-time farmers out of agriculture and have led to the absorption of more and more of the time which the smallholders with incidental non-agricultural jobs previously spent in agriculture. These changes are reflected in the increasing number of smallholdings without cattle. For example, in many districts in the northern part of Sweden, where only very small acreages can produce crops other than pasture and hay, the number of smallholdings without cattle has increased from 15 to 25 per cent. in the last five years.

If the present high level of economic activity continues, these two economic factors—the push of low incomes, which causes a low recruitment, and the pull of near jobs, which causes an outflow of middle-aged smallholders—may eliminate the problem of under-sized holdings in about two decades. But if this happens it will create a new problem. The disappearance of undersized holdings is only loosely connected with sales in the open market. There is already an abundance of strange types of tenancies and legacies. These may make farm planning and management precarious for those farmers who undertake acreages detached from old smallholdings. Thus we may face tenancy problems in Sweden tomorrow almost as severe as those of certain other countries today.

J. H. Smith, *University of Aberdeen, Scotland*

In the most common situations with which we have to deal an improvement in the ratio of farm to non-farm wages has a restrictive influence upon migration of workers from agriculture. We should recognize, however, that the simple relationship between wage ratios and rural migration is complicated by other factors.

Farm wages can be so low as to make migration from agriculture extremely difficult; workers cannot afford the cost involved in seeking industrial employment and migration. But as conditions improve a situation may ultimately be reached in which farm workers are able to take greater advantage of the social and cultural facilities offered in urban areas and urban employment.

Farm workers anxious to give their children the best available

education may move near or into towns where the educational facilities are of a higher order than those found in rural areas. More children of farm workers now receive an education which enables them to enter employment outside agriculture. The decline in the recruitment of youths to farming in Britain is due, at least in part, to the fact that families are smaller and education better.

High wages, by encouraging mechanization and intensive systems, may accelerate the movement of men from agriculture. They may also enable workers to forgo some of the possible earnings to be had in farming in favour of the more intensive social and cultural life offered in towns. There is evidence that young farm workers in some parts of England have left agricultural employment for less-well-paid jobs in towns.

In Britain we find that migration from agriculture is often least in areas where under-employment of farm labour is greatest and where earnings and conditions of employment are below the average for farm workers. The areas where the decline in numbers of farm workers is greatest are those where earnings and conditions of employment are above average and compare favourably with those which they can expect to enjoy in non-agricultural employment.

When comparing the relative advantages of different occupations farm workers take into account a wide variety of social and cultural factors as well as earnings and conditions of employment. They look at the opportunities for advancement of their children as well as for satisfying their own desires and well-being. It is a mistake to assume that the levels of wages in agriculture and industry are the only important factors governing the relationship between wages and employment in agriculture.

M. BANDINI, *University of Perugia, Italy*

In some extensively settled areas of the Mediterranean type—such as may be found in Southern Italy, South America, South Africa, Australia, and so on—the effect of mechanization is to reduce labour requirements per unit of produce. Owing to the fact that total production is increased, however, it often happens that the total labour requirements of the farm are also increased. This means that the general rule that mechanization reduces total labour requirements is not true in all situations.

H. A. PEDERSEN, *Mississippi State College, U.S.A.*

I can illustrate one of Dr. Pedersen's points from the experience of a large plantation in Mississippi. The plantation has about 20,000

acres, and at the beginning of 1940 it was primarily a tenant operation with a population of about 5,000 people. During the war years the population fell to 2,000 and the cotton acreage dropped from 10,000 to about 6,000. Then there was a change of management and a period of mechanization set in. The tractor inventory increased from 10 to 180 and the acreage planted to cotton was more than restored to about 11,000 acres.

The important point is the age distribution of the population. In the early period the modal age group was 30–40 years. In the latter period the distribution was bimodal in that there was a large segment in the age group 50–60 and a somewhat smaller segment in the age group 20–30. The younger age group included the semi-skilled and skilled workers recruited as tractor drivers, repair men, mechanics, and such. The wage labour included in that group was nearly quadrupled during the period. The professional personnel on the plantation was nearly trebled, increasing from about twenty to almost sixty. This latter point is usually overlooked when we discuss technological change on a national level. The same relationship may be observed in most countries in that the professional staff serving as consultants to agriculturists is greatly expanded in the effort to attain greater efficiency of production. I would say that the agricultural labour force is determined primarily by factors outside of agriculture, such as the general level of employment.

J. F. DUNCAN, *Aberdeen, Scotland*

As a congenital nonconformist I welcome Professor Pedersen who has had the courage to tell the organizers of the Conference that the subject was not to his liking and that he was going to give us another. The first comment I want to make is that his paper is an excellent example of the danger of applying economic theory to the crude statistics of population and to average figures. An average wage for the United States means nothing. I remember attempting at one time to work out the wages as recorded by Ducoff and others and discovering the staggering variation even in the high-wage States in the upper Middle West or in the New York area or in California. The variations in counties, let alone States, were such that the material could not be averaged to give figures of any value at all. When you apply economic theories to such crude figures and then attempt to relate the result to experience, you have to conclude that the people had refused to work according to economic theory, and that the facts were quite different from what you might expect. For instance, according to Professor Pedersen it would appear that we in Great

Britain had decided that we must pay higher wages to agricultural workers so as to retain them in agriculture during the war. We did not. We retained them in agriculture and then had to pay higher wages. We would not let them out, but they were not called up for war service. The result was that up to 1947 they had to remain there because of a control of employment Order, and then we had to set to work to raise their wages with no relation whatever either to agricultural prices or to anything else. As a matter of fact we had to fix agricultural prices high enough to pay the wages we had fixed to the people who were kept in agriculture. Now, you can apply your economic theories to that and see how they relate to these figures. Again, when you are looking at the numbers employed in agriculture there is an awkward fact which appears in 1947. The labour force in Britain decreased from that year onwards because we kept the 14 to 15-year-olds in school. The labour force responded not to economic forces but to purely political and social forces.

Joe Smith has put the point I wanted to put about high wages. I know something about wages in Scandinavia because in our International Land Workers Federation we had to deal with these things. It is a curious fact that you find practically the same movement in wages in Sweden, Denmark, Holland, and Great Britain. England has had statutory minimum wages from 1924. In Scotland, being again nonconformist, we did not have them until 1937. Between 1924 and 1937 wages in Scotland were subject to the operation of the free market. But the remarkable thing was that the operation of the free market maintained wages higher, on the whole, than the minimum rate in England during the period. In Sweden and Denmark they had no minimum rates; they had a system of collective bargaining, with the considerable amount of social conscience which has developed in the northern countries. As a result you find exactly the same movement going on in wages in Sweden, Denmark, and Holland as we have in Britain. I rather think that Sweden, with this collective bargaining system, has gone somewhat beyond our minimum rates. In the table which Professor Pedersen gives, the figures for Great Britain are the minimum rates; but investigations made by the Ministry of Agriculture and the Department of Agriculture for Scotland show these rates to be considerably below the actual rates of wages paid in the greater part of the country. The figures which ought to be taken into account are not the minimum rates but the actual wages paid. Further, I want to reinforce what Joe Smith said about high wages. We are told that the way to attract people back into agriculture is to offer high wages. You will never do it that way.

Nor will you be able to keep them with high wages. I am saying that after having spent my life trying to raise wages and having not been unsuccessful in doing so. I speak from experience and from the experience of my colleagues in other countries, and I say that in those sectors of the community where the lowest rates of wages are paid, you generally have a surplus of labour; otherwise you would not have the lower rates paid. It is in those sections of the community where the wages are highest that the worker is most ready to leave agriculture. You cannot give a man an appetite so long as he is desperately hungry. He only begins to exercise his choice in foods when he has had some experience of decent feeding. And once you give the agricultural worker the chance and raise him to a position where he feels he can make progress and that he can begin to have desires beyond merely basic things, then it becomes much more difficult to keep him in agriculture. That takes us into sociology; it takes us into a good many other things which we have not begun to investigate, as to why people leave agriculture. It is an old problem, much older than any of us here, and it will continue with those who follow us unless they set to work on something more than crude statistics, and on something more than out-dated economic ideas, such as that man always moves to where he can get for himself the best financial return.

J. PEDERSEN (*in reply*)

Mr. Britton has suggested that it may be necessary for Denmark to consider the possibility of receiving immigrants as farmers. To this suggestion I would answer that the maintenance of the labour force in agriculture is not an end in itself and that an increase in population would hardly raise *per caput* real income in the country. If the immigration spoken of were persistent and substantial it would lower the level of real wages both in agriculture and in industry. Such a policy could be defended, therefore, only on grounds of equalization of incomes between countries or of the desirability of generally free movement of labour in the world.

So far the process has been that industry has absorbed labour from agriculture by offering higher prices for labour than the farmers were prepared to pay. Therefore the farmers have let the labour go. This is in close correspondence with general economic theory, and is verified by the facts represented by the figures which I have given in my paper, and in which Dr. Duncan does not believe. I would like to ask Dr. Duncan why statistics are gathered all over the world if they are

of no use. I must admit that British statistics have been less abundant than statistics for some other countries, but perhaps that is because of the influence of Dr. Duncan.

There has been some criticism, especially from our Swedish friends, of the underlying material which I have used; but everybody will understand that there is a limit to the work that I could devote to the preparation of this paper. I may go into greater detail later.

Mr. Britton also said that the decline in the agricultural population during the transition period causes sufferings which we should mitigate as far as possible. In this respect I would point out that it has seemingly not so far afforded any suffering. People are leaving agriculture voluntarily because of the possibility of obtaining higher incomes elsewhere, so that it has been necessary to induce them to stay by paying them higher wages. I do not know if Dr. Duncan could devise other means, perhaps of a sociological nature, to keep them. It has interested me greatly to learn that the behaviour of the labour market in Japan has been very similar to that of Denmark. Under conditions of serious unemployment in industry, people are kept on the farms because they have no possibility of emigration, or because trade unions keep wages up in the towns whilst we in agriculture have a flexible wage. People therefore tend to go back to the land. You find, in fact, a couple of years in the U.S.A. during the depression when there was an increase in the agricultural labour force. This all goes to show that statistics are not so valueless as incicators of economic forces as Dr. Duncan thinks. There seems to be the same relationship between these figures in almost all countries, and that ought to be proof of their usefulness to illustrate the forces at work.

Dr. Holmström said that the description I gave of popular opinion about the causation of the process that has been going on was not correct. But this indicates only that people in Sweden are considerably more intelligent than we are in Denmark and elsewhere. His statement is not quite representative of the general opinion. If you read what is written about this problem in newspapers and even in professional journals you do not find the same opinion as that offered by Dr. Holmström.

I will return to Mr. Britton, who said that the F.A.O. have calculated that in Denmark we have about 12 per cent. surplus labour in agriculture. I did not quite catch his definition of surplus labour, but one possible definition I suppose would be that surplus labour exists to the extent that you can eliminate labour without reducing produc-

tion. On this definition, I doubt whether that calculation is correct. But it is true that by a certain amalgamation of farms you could reduce the labour force to some extent without reducing production. However, the possibilities of doing this are limited, because Danish agriculture is based on intensive production of animal products which does not lend itself to extensive mechanization.