

Agriculture in Denmark, 1870-1939. From asset to liability?

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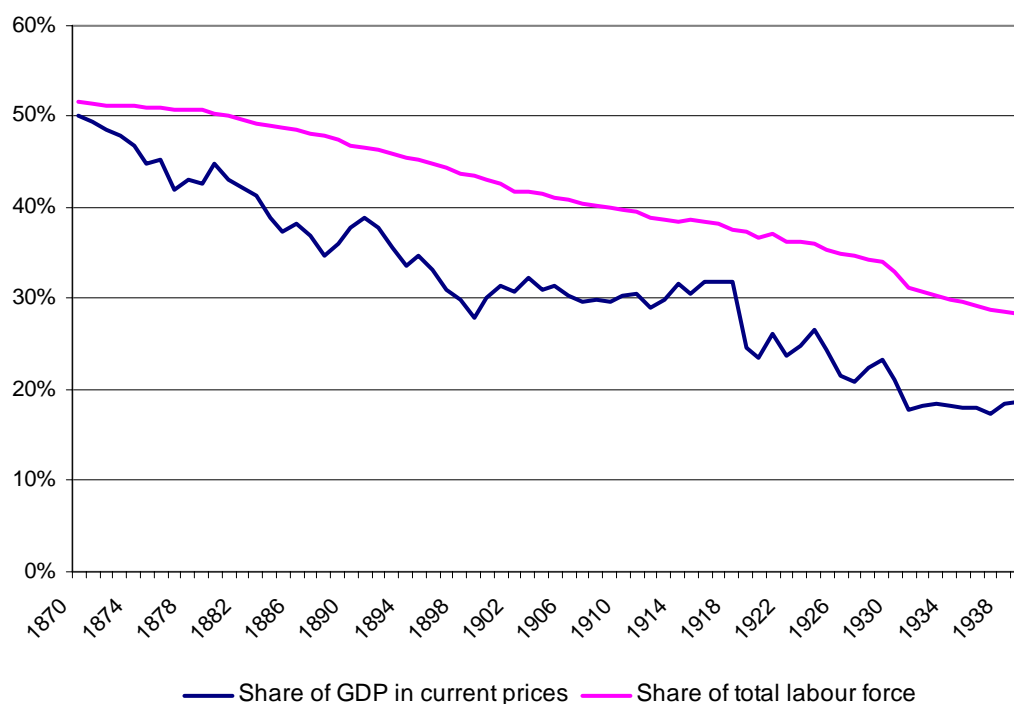
Introduction

Danish agriculture made unique contributions to economic growth during 1870-1914. The title indicates that the record was more mixed after that time. First, the dominance of agriculture put the Danish economy in a vulnerable position during the depression of the 1930s. Secondly, even after WWII, during the so-called Golden Age of European growth, Danish growth was for a prolonged period of time below average mainly due to the dependence on agricultural exports. The first part of the paper will provide an overview of the development in the main variables 1870-1939. Section 2 will deal with the period 1870-1914 in the light of international and Danish literature on the subject. Section 3 that deals with 1919-1939 is mainly based on Danish literature. Section 4 concludes.

1. Agriculture's contribution to economic growth in Denmark 1870-1939

A first impression of the relative importance of Danish agriculture in the economy throughout the whole period of time can be gained from Figure 1. The low 'productivity gap' from the outset in the 1870s and again in the first decade of the 20th century is noteworthy especially since the labour productivity of Danish agriculture at the time compared favourably with that of other rich nations with the exception of the UK. Denmark had by then become a rich nation in spite of agrarian dominance.

Figure 1 Agriculture's share of GDP and of total labour force



Source: Calculation from Hansen (1984) pp. 229-234 and 238-243

The growing export orientation of Danish agriculture from the late 1880s paved the way for an expansion in transport, commodity trade and other services, confer the more detailed account in Table 1.

Recent research in historical national accounts (Nilsson 2004) has questioned the balance between sectors that we see in Figure 1 and Table 1. Nilsson among other historians has argued that the modern creameries and bacon factories that emerged from the late 1880s and early 1890s ought to be included under the heading of “industry” rather than agriculture. The value added of these businesses is traditionally included in agricultural GDP. Many of them were small enterprises. Most creameries had a staff of less than 6 persons. Their value added was small, that is the value of their input of agricultural raw materials made up a large part of their production value.

Nevertheless, as Nilsson and Hyldtoft (1999) would claim, they were industrial enterprises. They invariably employed mechanical power and the modern production methods of their time.¹ In present day national accounts they would, of course, belong to “food industry”.

Table 1. GDP by sector in 1929 prices

Sector	1870	1880	1890	1895	1900	1910	1920	1921	1930	1939
<i>Primary sector</i>	50,1	44,9	37,8	34,7	30,2	30,3	23,6	26,1	21,1	18,6
<i>Secondary sector</i>	20,0	19,4	22,2	23,2	26,2	24,3	27,3	23,2	27,7	32,1
Including:										
Trade	12,1	10,9	12,2	11,4	10,0	8,6	8,2	7,5	8,7	9,5
Industry	4,1	5,2	6,6	7,8	10,0	9,9	15,2	10,8	11,6	15,5
<i>Tertiary Sector</i>	29,9	35,7	39,9	42,1	43,6	45,4	49,1	50,7	51,2	49,3
Including:										
Commodity trade	7,8	9,9	11,8	13,1	14,2	14,8	18,4	18,7	18,3	17,4
Transport etc.	2,8	4,0	4,6	5,3	7,0	7,1	9,0	8,2	8,8	9,2
Total	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0

Source: Hansen (1984) pp. 238-243.

Note: a) The secondary sector in this case is inclusive of public utilities and construction.

b) The Figures from 1921 includes North Schleswig, Sønderjylland, reunited with Denmark in 1920, see Appendix B for details.

The alternative series calculated by Nilsson is shown in Appendix Table 2. Trade and industry, including public utilities, according to this recalculation made up 25 per cent of total GDP compared to agriculture’s 21 per cent in 1900. In other words the Danish economy according to this view appears more “industrialized” at an earlier date than in conventional historiography.

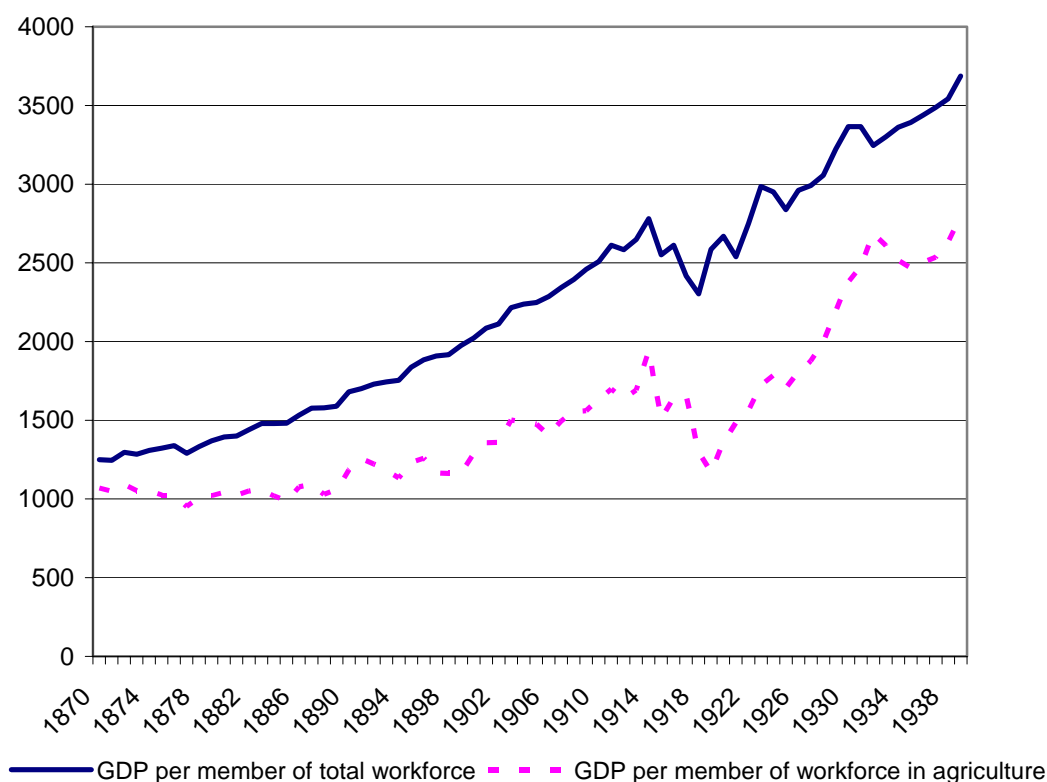
The following potential linkages between agrarian change and economic development can be identified (see, for example, Allen 2004, pp. 114-116).

1. Agricultural output grew during most years, although we distinguish between separate phases, confer Figure 2. Denmark was relatively hard hit at the beginning of the European depression of the 1870s. We find that agricultural production per member of the agricultural workforce in fixed

¹ By which we think of the results from scientific research in, for example, biochemistry.

prices stagnated and declined. The Danish response to the ‘Grain invasion’ is described in detail in Section 2. The positive effects of the response were perceptible from the late 1880s where after Danish agriculture entered a growth path that with minor interruptions was to last until WWI. During that time Danish agriculture developed a high degree of dependency upon imported inputs mainly in the form of grain, other animal feeds and fertilizers. The value of imported raw materials made up no less than 41 per cent of the value of gross agricultural exports (exports before deduction of imported raw materials) during 1910-13. This participation in the international division of labour became a serious obstacle to domestic production as international trade grinded to a halt in the last two years of WWI.

Figure 2 GDP in 1929 prices per member of the workforce



Source: Calculation from Hansen (1984) pp. 229-31 and 250-259

The recovery after the war was somewhat delayed, partly because dairy farming was a major production line and it takes time to rebuild herds, partly because of the collapse in prices 1920-

22. New owners who had bought their farms at the war price level anticipating that it would last were, of course, particularly hard hit.

Recovery, however, does only in part explain the high growth rates of agricultural GDP from 1921 until 1931. Economic indicators such as the development in agricultural terms of trade and the, somewhat doubtful, calculations of the returns on agricultural investments, suggest that the relative importance of agriculture in the total economy should have been reduced at a much faster rate than the one we observe in the Figures 1 and 2. Hansen (1984, p. 56) puts the development down to the reaction of individual producers under perfect competition who try to make up for declining prices through increasing quantity. Denmark was by then a large player on the British market for animal products. The development in total volume, international price trends apart, is thought to have depressed prices even further. This paper will suggest an additional explanation on the supply side.

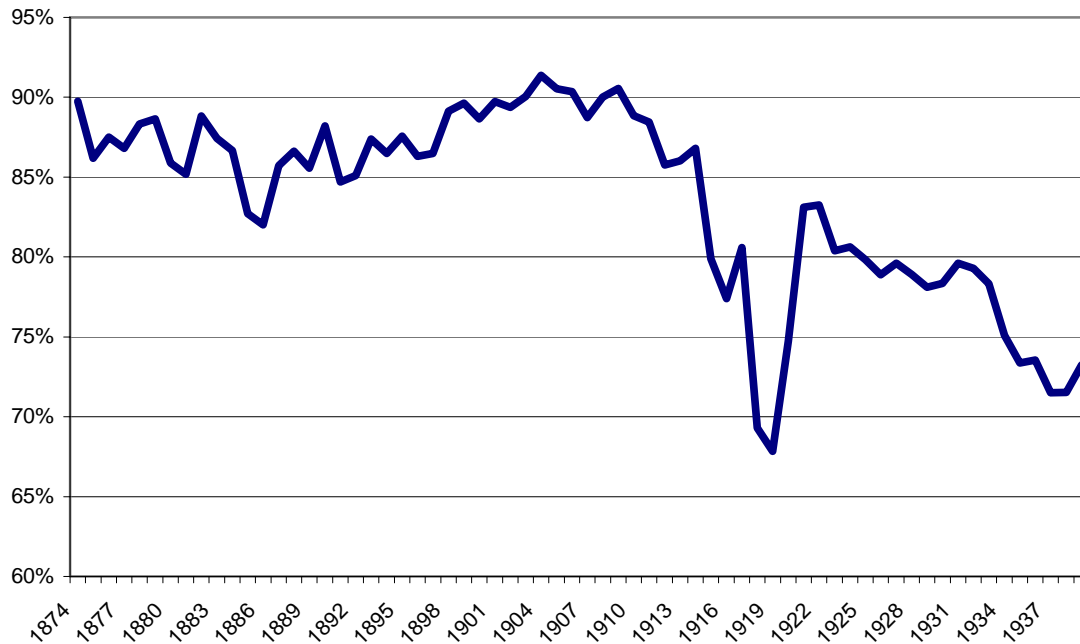
The full blow of the Great Depression was not felt in Denmark until 1931² since the prices of imported grains had declined even more than the prices of animal products at the beginning of the crisis.

First and foremost the growth in output per agricultural worker and per head of total population involved a substantial increase in the value of the exports of agricultural goods net of the value of imported raw materials for agriculture. The export performance relative to agricultural GDP is shown in Appendix figure 1. The rising trend in net exports started in late 1880s going from 20 per cent of GDP to 60 per cent in 1914 only to peak in 1931 at 75 per cent.

The export of agricultural goods led growth in the total economy, successfully it would seem, until the beginning of the 1930s, see Figure 3. Agricultural goods as a share of total Danish exports made up to about 90 per cent before WWI. After the war it recovered to around 80 per at the onset of the depression leaving the Danish economy in a susceptible position. During the 1930s it slumped to around 70 per cent. The latter development was mainly the effect of the development in relative prices, although there was a slight increase in domestic food consumption because of government measures to alleviate the agrarian crisis.

² The high production figure for 1932 is misleading since it was influenced by an unusually good harvest that year.

Figure 3 Agricultural exports as per cent of total export



Source: Calculation from Bus Henriksen and Ølgård (1960) pp. 46-51

2. There is hardly any doubt that Danish agriculture provided an important home market for manufactures. Evidence is the low export quota, below 10 per cent, of Danish industry even at a period of time, around the turn of the century, when industry grew fast. On the micro level we find industry supplying agriculture and the agricultural processing industry with capital goods such as sowing and threshing machines, tiles, cement and, later on, cream separators and other machines to the modern creameries (Hyldtoft 1999, Etwill 1993). Danish manufacturing in its early stages was, however, dominated by a broad spectrum of consumer goods. Given the structure of population the farm population must have absorbed an important part of goods like clothing and textiles, furniture, beer, tobacco etc.

3. We do not know whether agriculture was a net provider of capital for investment in urban trades at different stages. From the mid 1890s and especially after the turn of the 19th century agriculture's own investments soared, something that speaks against a positive net contribution. It is equally not clear whether tax receipts from agriculture outweighed public expenditures benefitting agriculture such as loans subsidies, subsidized branch lines, subsidized extension services etc.

4. Danish agriculture contributed to economic growth through the release of labour. This is true if we define release of labour as “a rise in output per worker that allows a decline of the fraction of the workforce in agriculture” (Allen 2004, p. 116 quoting Crafts). In absolute numbers the work force peaked as late as 1929, confer Appendix figure 2 . High population growth, however, doubled the total labour force and secured a continuous flow of labour to employment outside agriculture. The urban labour force more than tripled during 1870-1939. Nevertheless, in Section 3 below we argue that the release of labour from an allocation point of view might have been insufficient during the 1920s in particular.

2. 1870-1914 – a case of successful adaption

2.a Looking back: Danish agriculture in 1870.

Danish agriculture was already in a relatively favourable position in 1870. Van Zanden (1991) placed Denmark at the ‘efficiency’ frontier in 1870 together with Belgium, the Netherlands and Britain. “With their specific resource combinations, these countries had realized the highest levels of agricultural production per hectare and per head.” (p. 219)

The Danish land/man ratio stood out with almost three hectares per person dependent on agriculture compared with only one hectare in Belgium. Consequently, the Danes at that time had specialized in relatively land intensive rather than labour intensive production. Furthermore, Van Zanden finds the share of the non-agricultural population in 15 European countries highly correlated with total agricultural productivity. Britain, the Netherlands and Denmark represent outliers in his regression with Denmark and the Netherlands having ‘too small’ a population share in non-agriculture. This, of course, can be explained by the division of labour between these two agrarian economies and industrialized Britain that was already well under way in 1870. Crafts (1985, ch. 3) examined structural change during economic development in 14 European economies during 1840-1910. Although there is a strong tendency for the proportion of the labour force in agriculture to decrease as income level rises, there are, on the other hand quite striking differences “indeed large enough to suggest the validity of O’Brien & Keyder’s insight that there were substantially different paths to modernity followed during the nineteenth century.” (p. 56) Furthermore, on a similar theme individual countries exhibit occasional idiosyncrasies

such as Denmark with its very productive agriculture, which ensured that this country had no sectoral productivity gap at the income level reached in 1870.³

Comparable data on capital endowment is fragile. O'Brien & Prados de la Escosura (1992) deems this data "not adequate or accurate enough to compare levels and changes in total factor productivity" (p. 515). A simple proxy, the number of livestock per person in agriculture, shows that Danish farmers had an initial advantage in 1870⁴ over its European competitors with the exception of Ireland (Thomsen 1966, p. 142).

2.b Growth and productivity: the overall view

Some recent comparative studies of late nineteenth century European agriculture referred to below include Denmark. Van Zanden (1991) converted the production of various goods to wheat units. O'Brien & Prados de la Escosura (1992) used backward extrapolation from end year estimates of outputs expressed in US prices for 1960 to calculate the development in the relative size of land and labour productivity.

Van Zanden found high rates of growth of both production and productivity 1870-1910 in Denmark, Germany, the Netherlands and Belgium. Danish agriculture according to Van Zanden comes second only to German agriculture when the growth in production per head and in production per hectare is considered. In all four countries the gain in productivity is attributed more to land-saving than to labour-saving technological progress. That is chemical fertilizers, with the exception of Denmark, and imported animal feeds. The progress of labour-saving technology was hampered by farm size and by the state of art in motive power as long as the steam engine dominated. This, on the other hand, did not hold back mechanisation in places where one machine could be shared like continuous cream separators; see below on modern creameries, and threshing machines. In accordance with the Danish resource endowment labour saving was relatively larger than in countries with a low land/man ratio like Belgium and the

³ Probably the labour force data from Mitchell used by Crafts underestimates the labour force in agriculture. According to Hansen's (1984) data there was a productivity gap, albeit a small one in 1870, confer Figure 1.

⁴ 687 pieces of cattle per 1000 inhabitants in 1871. In 1881 the number had risen to 736 compared to 348 in the Netherlands and 308 in France (1879 figure). We must, however, allow for the superior quality of Dutch cattle compared to Danish cattle at the time.

Netherlands. Consequently, the rise in Danish land productivity was relatively modest until late in the first decade of the 20th century, see, Appendix figure 3.

O’Brien & Prados de la Escosura not only used a different method for comparison than the one used by Van Zanden they also use different data sets, that is total agricultural land including pastures meadows, rough grazing etc. instead of just arable land and male labour force in agriculture instead of total agricultural workforce. The latter was counted differently in different European countries. When calculated this way the Danish land/labour ratio in 1910 is placed at 73 per cent of the British ratio. The main point made by these authors is that “the progress and relative efficiencies of agricultural production in different countries are best compared within a resource heritage of similar or potentially comparable land labour ratios.” (p. 53). “European farmers (including the Dutch and the Danes) continued to operate with significantly lower ratios of land to labour than British farmers... They had... used their abundant resource, labour, to intensify the cultivation of land and to maximize monetary returns per hectare. With so much underemployed and family labour time at their disposal they had not proceeded nearly as far as British farmers in purchasing agricultural inputs (machinery, tools, fertilizers, chemicals and power) and urban services (transportation, distribution and financial assistance) from specialized industrial and service sectors.” (p. 529)

In the twentieth century North-western Europe converged towards UK levels as the relative size of the agrarian work force declined over time. Denmark and the Netherlands surpassed the lead country in this process. Table 2 below is an excerpt from Table 6, p. 531

Table 2 Output per worker (pre-1922 UK = 100)

Year	Netherlands	Denmark	France	Germany	Italy	Spain
1890	82	44	52	63	28	33
1910	90	107	55	68	30	31
1930	94	127	58	55	30	41
1950	94	97	51	42	22	20

Output per male worker (pre-1922 UK=100)

Year	Netherlands	Denmark	France	Germany	Italy	Spain
1890	89	82	72	89	45	38
1910	92	147	82	118	45	32
1930	91	162	88	104	43	39
1950	84	131	71	69	28	19

Output per hectare (pre-1922 UK=100)

Year	Netherlands	Denmark	France	Germany	Italy	Spain
1890	192	140	128	148	146	58
1910	237	202	136	205	161	55
1930	282	270	153	218	180	61
1950	310	228	111	176	134	46

Source: O'Brien and Prados de la Escosura (1991) excerpt.

Note, that the increase in output per male worker and per worker between 1890 and 1910 was even faster in the Danish case than the increase in output per unit of land. The difference between Denmark and the Netherlands in this respect can easily be explained by the initially higher land /labour ratio in Denmark, but the difference from France and Germany can not.

In a new comparative study concentrating on an important branch of North European agriculture Henriksen & O'Rourke (2005) give an insight into one of the forces behind the growth in output per worker 1890-1910. Based on import data to the important British market we show that Danish dairy farmers at an earlier stage than their European competitors, mainly Ireland and the Netherlands, switched from summer to year-round dairying. We also find that Danish dairy farmers held on to the principle of year-round dairying even in the face of strong competition from Australia and New Zealand beginning in the 1890s. By letting their milk cows calve in November or December and feed them generously throughout the winter the farmers effectively prolonged the productive season by three or four months. The costs of intensive feeding during the wintertime were more than made up for by a winter price premium of 20-30 per cent. Year-round dairying resulted in a higher rate of utilisation of agrarian capital that is of farm animals and of the modern cooperative creameries set up from the late 1880s. The latter played an active

part in the switch to winter production by forcing the members to buy a minimum of feeds per cow during the winter months. The new principle also resulted in a higher rate of utilization of labour. Hansen (1984, p 226) observes” that a rise in real wages in agriculture [see below] from the 1870s introduced greater economy in the use of labour. The increase in beet growing [for cattle feed] and the increase in milking work could be met by cheap [previously underemployed] female labour...”. Some of the new labour intensive tasks like weeding the beet roots fell outside the grain harvest season, which was otherwise a bottle neck for the use of labour. This may account for some of the difference in the productive gain of all workers and of male workers in the Table from O’Brien & Prados de la Escosura, see above. It seems to be unique for Denmark.

In a recent national study Hyldtoft (1999) has made the first attempt to calculate a growth account of Danish agriculture 1875-1910, divided into two sub periods, one of moderate growth 1875-1895 and one of comparatively high growth 1895-1910. Besides the well known reservations concerning the assumptions behind this kind of exercise, the data is deficient, not least when it comes to the size of the capital stock. Hyldtoft is mostly concerned about the size of capital in 1875 and about the weights of the factor contributions. His data set is from Hansen (1984), Kærgård (1991), and the official statistics on agricultural land. He chooses to include land in the growth account because of a non-negligible growth in this factor 1875-1895 mostly due to moor reclamation.

In spite of high population growth the agricultural labour force stagnated from 1880 and even declined a little due to increasing migration to towns and, to a lesser degree than in other European countries, overseas. Note, that this is a period of time with only a moderate increase in the number of newly established cottages and small holdings compared to later periods. After young farm servants had left the countryside to become wage earners in urban trades the real wage of agricultural workers (male live in servants on the farm) rose by about 50 per cent over the period 1875-1895.

It looks as if the net rate of investment during this period was fairly low, 3,4 per cent of agricultural GDP at factor costs (Hansen 1984, pp. 222 and 242) It may seem a bit surprising since the late 1880s saw the greatest surge in the establishments of modern creameries all over the country. The costs of these plants are, however, known fairly accurately and they did not amount to much. Nor did the modernisation of the butter processing entail any further mechanisation on the farm level. The response of the dairy farmers was, as we have seen, to

purchase more feed and to expand their stock of animals. From the late 1880s we find a large expansion in the number of pigs on the dairy farms. They were fed by the skimmed milk left over from butter processing in the creameries and returned to the farmer, thus making butter and bacon a joint production.

Any labour saving investments took place in grain production.

Table 3 An early growth account of Danish agriculture

	$\Delta Y/Y$	$\alpha \cdot \Delta C/C$	$\beta \cdot \Delta L/L$	$\gamma \cdot \Delta N/N$	t^*
1875-1895	1,01	0,35 · 0,61	0,5 · 0,09	0,15 · 0,39	0,69
Contribution		Capital 21,2%	Labour 4,5%	Land 5,9%	Tfp 68,3%
Growth p.a.		Capital productivity 0,40%	Labour productivity 0,92%		
1895-1910	2,14	0,35 · 1,95	0,5 · 0,23	- 0,15 · 0,00	1,35
Contribution		Capital 31,9%	Labour 5,4%	Land – 0.1%	Tfp 63,1%
Growth p.a.		Capital productivity 0,19%	Labour productivity 1,91%		

Source: Hyldtoft (1999 pp. 145 and 228)

If we believe in the estimates of the contributions made by land, labour and capital a lot is left to total factor productivity and to the interpretation of this residual. Hyldtoft (p. 148-49) stresses the fast shift itself from grain to butter and bacon. Land fertility improved because of the increase in the production of manure and in imported fertilisers. When beets replaced grain on some fields, feed production per hectare went up. Finally, collaboration between agricultural scientist and farmers intensified from the 1880s. This effort was facilitated by the agricultural extension services. The consultants were employed by the local farmers' associations, which communicated research results to their members. In the 1890s the number of members is said to have been around 50.000.⁵ As literacy was generally high⁶ new technology was spread by written media as

⁵ The number of middle sized farms which made up the main recruitment base of the farmers' associations was by then 73.000. Consequently, the coverage was fairly extensive.

well. In accordance with this Henriksen & O'Rourke find a positive statistically significant correlation between newspaper circulation in Danish counties and declining seasonality in dairy production.

The growth in agriculture 1875-1895 was modest compared to that in urban trades. According to Hyldtoft GDP at factor costs in all sectors outside agriculture grew by 3, 07 per cent p.a. to a large extent driven by a growth in the transaction sector that serviced Danish agriculture's increasing participation in the international division of labour, confer, again, Table 1. Modern industry probably grew by as much as 5 per cent p.a. but still made up only 9, 3 per cent of total GDP in 1895.

During 1895-1910 growth in agriculture accelerated. Not surprisingly the contribution by capital increased although Hyldtoft remarks that the available data probably exaggerates capital formation. The surge in investments was most pronounced 1903-1907 when net investments are estimated at 14 per cent of GDP. New buildings for larger herds made up about half of the investments. Perhaps more interestingly, the share of machinery, threshing machines, mowers, reapers and American steel ploughs, increased from 20 to 30 per cent of total investments in the new century. As a consequence, the growth rate in labour productivity doubled. This happened in spite of a renewed growth in the agrarian labour force⁷, especially after 1900. The growth is closely associated with official Danish land policy, confer section 3 below.

There is still a large residual to be accounted for in 1895-1910. Besides the effects from new machine technology some progress were made in cattle farming that made for more productive and healthier animals. Similarly, progress was made in the sorts of roots chosen, whereas grain growing changed little. Some of the same forces were at work during this compared to the previous period. The number of members of farmers' associations had risen to 86.000, and the number of members of the new small holders' associations established in 1896 was 39.000, by 1910.

⁶ A test in 1881 established that 78 per cent of the Danish recruits for military service could read. The figure would have been no different for young women.

⁷ Seasonal workers from the neighbouring countries, in the 1880s from Sweden and in the first decade of the nineteenth century from Poland, worked mostly in the beet fields. There were almost 10.000 Polish seasonal workers in Denmark in 1910 who are not included in the calculation of the labour force.

Looking at the urban sectors Hyldtoft still finds a higher GDP growth, 3, 64 per cent p.a. during 1895-1910, than the growth rate in agriculture. This is obtained at higher measurable inputs of both capital and labour than growth in agriculture. Most interestingly for our purpose, however, he finds that labour productivity in the urban sector of the economy grew at almost exactly the same rate as in agriculture, 1, 90 per cent p.a. This could indicate that labour was not (yet) seriously misallocated.

2.c Open economy forces. The reaction to the grain invasion

Kindleberger (1951), in his seminal article on international trade, observed that “The response that will be made to an economic stimulus in international trade cannot always be predicted from the nature and event of this stimulus.” (p. 46). This characterization is not least aimed at the Danish reaction to the grain invasion of the 1870s⁸. Like Britain, the Netherlands and Belgium, Denmark did not impose a tariff on grain in spite of the strong agrarian dominance in society and politics. Economic theory predicts that landowners should have favoured agricultural tariffs whereas the preferences of labour remain theoretically ambiguous. In a Heckscher-Ohlin framework, however, European labour as the abundant factor should have favoured trade (O’Rourke 1997, p. 778)

As it turned out the Danish response raised the level of real income of the producer group at the same time as it preserved the gain of cheaper bread for the consumer (Kindleberger, p. 44). Proposals to impose tariffs on grain and later on cattle and butter were turned down by farmers’ associations on several occasions. The majority of farmers seem to have realized the advantages accruing from the free imports of cheap animal feed⁹ during the ongoing process of transition from vegetable to animal production, see, Appendix figure 4. The leading group of farmers (although not the most numerous group) was made up of those with middle-sized farms of about 50 acres (Jensen 1933, p. 133). This size was inefficient for wheat but had its comparative advantage in intensive animal farming at the given technology. As we have seen already Danish landowners contrary to prediction expanded arable land in order to feed their growing herds of animals.

⁸ Kindleberger included Britain, Germany, France, Italy and Denmark in his analysis.

⁹ From 1883 on Denmark went from being a net exporter to be a net importer of grain and other feeds.

Table 3 Factor prices, 1875-1913**Real wages, 1875-1913**

	France	Germany	Great Britain	Denmark
1877	100,0	100,0	100,0	100,0
1882	105,2	96,5	104,0	112,1
1887	113,9	110,0	113,9	126,6
1892	116,9	110,2	118,8	138,1
1897	123,1	124,6	127,6	180,7
1902	132,2	131,2	121,6	204,0
1907	142,3	132,9	128,6	224,8
1912	122,2	135,1	125,9	252,2

Real land prices, 1875-1913

1877	100,0	100,0	100,0	100,0
1882	95,6	94,0	77,3	108,9
1887	82,9	102,4	76,1	97,5
1892	89,2	90,1	76,7	90,0
1897	84,5	92,1	82,2	89,3
1902	81,8	97,8	69,8	85,3
1907	89,8	101,8	68,3	97,8
1912	84,7	108,0	58,2	111,2

Wage-Rental Ratios, 1875-1913

1877	100,0	100,0	100,0	100,0
1882	110,1	102,7	134,5	103,0
1887	137,3	107,4	149,7	130,2
1892	131,1	122,3	154,9	153,3
1897	145,7	135,2	155,2	202,2
1902	161,6	134,2	174,1	238,8
1907	158,3	130,6	188,2	229,4
1912	144,2	125,0	216,3	223,6

Source: O'Rourke 1997 p. 787 (excerpt)

Nearly half a century after Kindleberger wrote his article, O'Rourke (1997) provided the most thorough quantitative assessment so far of the effects of the grain invasion on a number of European economies. He gives an additional reason for the Danes to remain free traders: "The

grain invasion did not lower grain prices in Denmark as much as elsewhere¹⁰ and only lowered Danish rents by 4-5 per cent. This surely helps explain Denmark's willingness to stick to free trade as does the fact that Denmark had a comparative advantage in many agricultural commodities that were largely (inter-continently) non-traded." (p. 799). The excerpt of O'Rourke's Table 5 (p. 787) in Table 3 shows that Danish land prices did not decline during 1877-1911 while real wages rose (according to expectation) but more than in any other agrarian economy and more than in industrialized Britain, resulting in more than a doubling in the wage-rental ratio.

2.d Organisation and technology

This section will touch briefly upon three factors that influenced innovation and growth in Danish agriculture. These are the system of land ownership, the organisation of agricultural processing and marketing, and agricultural credit.

About 75 per cent of all arable land towards the end of the nineteenth century belonged to the acclaimed middle-sized farm. This share did not change radically as the new small holdings dealt with later on in this paper obtained their land from estates, rectories and newly acclaimed land. In an era of fairly high population growth, between 1, 0 and 1, 2 per cent p.a., the principle of equal inheritance was offset by easy access to credit. Loans from the credit associations that began to be effective from the 1870s enabled the farmers brothers to buy out their share of the patrimony. Land reforms during the late eighteenth century plus a new wave of acquisitions during the 1850s and 1860s had left the vast majority of these farms, representing 92 per cent of their land, as owner-occupied as opposed to tenanted.

As said already labour saving investments on the bigger farms were entirely confined to vegetable production, only indirectly serving animal production. The first agricultural census that included machinery was made in 1907 (*Statistiske meddelelser* 4,34,2) . By then the stock of threshers (24,5 per cent of the holdings), reapers (10,3 per cent) and sowing machines (12,2 per cent) at par with German and Swiss farmers and above other farmers according to Van Zanden (p. 234). According to the same source harvest machines were shared, hired or lent as an alternative to ownership. Although the expected threshold acreage, below which no farmer would by a machine, is established in the material, it appears that small farms were not totally precluded

¹⁰ By far the most important grain in Denmark before and after the grain invasion was barley and the real price of barley declined by less than four per cent in Denmark compared to a 33 per cent real decline in the wheat price.

from the use of machinery. A labour saving device like the milking machine, first introduced into many British stables during WWI, did only slowly find its way in Denmark during the 1930s.

The acreage of small and middle-sized farms no doubt slowed down the application of the most advanced (American) farm technology. Danish farmers, however, were not adverse to new technology. It took them only a few years to embrace the steam driven continuous cream separator, invented in 1878. This device skimmed more cream from a kilo of milk than conventional methods and had the further advantage of allowing transported milk brought together from a number of suppliers to be skimmed. Thus, modern creameries allowed small and medium sized producers to obtain the economy of scale in processing and marketing. From the 1880s the majority of these creameries in Denmark were established as cooperatives and about 20 years later, in 1903, the owners of 81 per cent of all milk cows supplied to a cooperative.

Ó Gráda (1977) compared the Irish and the Danish experience with cooperative creameries and points, among other things, to the importance of distance when dealing with the transport of a perishable product. In regions where Irish dairy farmers were as densely located as were their Danish peers the records of modern creameries were not much different. Henriksen (1999) is in accordance with this when examining creameries in Danish regions. Contrary to Ó Gráda it is argued, however, that the transport problem mattered for the mode of ownership. The first modern creameries in Denmark were private enterprises, but from the late 1880s they were ousted by cooperatives. Before the advent of mechanical refrigeration and fast modern transportation the working of these enterprises at an efficient level depended on large daily supplies of fresh, unadulterated milk from nearby dairy farmers. Consequently, private owners, according to contemporary records often found themselves in a “hold-up” position where they could not make demands on suppliers for fear of losing their supply.

Cooperatives could make and indeed did make demands on the supplier/owners. The statutes signed by the cooperative members specified the rules concerning fraud by adulteration of the milk and by untimely exit from the cooperative, and the punishments for breach of these rules. In a new micro level analysis based on the minute books of more than 200 cooperatives (Henriksen & Hviid 2004) we show that these rules were relentlessly enforced in the early Danish cooperatives resulting in a marked decline in the incidence of fraud. We speculate that this development together with the economic results boosted the dairy farmers’ interest in membership. We also find that a somewhat overlooked aspect of the Danish organisational

success was the relatively frequent use of the courts of law in solving conflicts between cooperatives and their own members. To put it in another way, the easy and non-costly access to an uncorrupted legal system was instrumental in the trust among participants as basis for cooperatives.

Credit cooperatives, which were successful elsewhere in Europe, never really took off in Denmark in contrast to other cooperative enterprises in this country. In Guinnane & Henriksen (1998) we find that in the 1860s the local savings banks already served the need of small borrowers with little to pledge who elsewhere was the clientele of credit cooperatives. The bigger regional savings banks advanced loans to larger borrowers backed by mortgage. These savings banks also financed most of the cooperatives. The so-called credit associations were cooperatives whose members took out cheap loans backed by -mortgage. By 1880 they overtook the savings banks as the most important source of institutional credit to agriculture. These two institutions, the savings banks of various size and functions and the credit associations, were established on local or regional initiative and probably covered the needs as broadly as similar institutions elsewhere on the European Continent if not better¹¹. Two things must be kept in mind, though; most funding was still financed out of retained profits and land policy from 1899 entailed an element of state loans.

3. 1914-1939 – A story of predictable decline?

3.a Growth and productivity: the overall view

The main argument carried forward in this part of the paper is that the official ideology, supported by official Danish land policy, was detrimental to economic growth in the long run. In the short term, when the world depression hit Denmark with a minor time lag, the economy was overspecialised. Agriculture still employed one third of the total workforce while its contribution to total GDP was a bit less than one fifth. Perhaps more importantly, Denmark was a small open economy with agricultural goods still making up 80 per cent of total exports. After the Great depression hit Danish agriculture in 1931, with a lag of one year, the options were severely limited. From 1929 to 1932 the price index for animal products fell from a 100 to 54. Among the effects directly on agriculture was an dramatic increase in the debt of farmers as per cent of the

¹¹ When measured as institutions per 1000 inhabitants or per square Kilometre.

mortgage value from about 49,7 per cent in 1909 to 75,7¹² in 1937. Some 7.200 farms and holdings were sold by court order 1929-35, more than 2.000 in the worst year 1932¹³ (Pedersen 1975 pp. 75, 80 and 84)

At a first glance the growth account for agriculture during the 1920s looks impressive, see Table 5. We must also remember that labour input is measured in the number of (adult) persons not in the number of hours worked. As we will see the development in ownership structure and the pattern of investments both point towards a harder workload during the 1920s carried by the owners of minor farms and small holdings.

Table 5 A growth account exercise for agriculture 1910-1939

	$\Delta Y/Y$	$\alpha \cdot \Delta C/C$	$\beta \cdot \Delta L/L$	t*	Growth in Y/L p.a.
1910-21	0,26	0,45	0,80	-0,99	-0,87
1921-31	4,90	0,42	0,97	3,51	5,26
1931-39	1,36	0,24	-0,14	1,26	2,05

Source: Calculation based on Hansen (1984) pp. 231, 251

Note a) $\alpha=0,3$ and $\beta=0,7$ as suggested by Maddison (1991)

b) The 1921 data includes Sønderjylland (North Schleswig)

The growth record of the urban trades during the 1920s, see Table 6, was also fairly good but some exogenous shocks hit manufacturing and construction hard. Due to the effects of the real appreciation of the currency 1925-26, unemployment among the insured employees was as high as 22 per cent in 1927. These developments may have served to support the official ideology when it came to land policy.

¹² 81,4 per cent if we include some short time debts including state subsidized loans.

¹³ Corresponding to 1 per cent of all farms (204.000) at the 1933 census.

Table 6 Growth in GDP and labour force outside agriculture in per cent p.a.

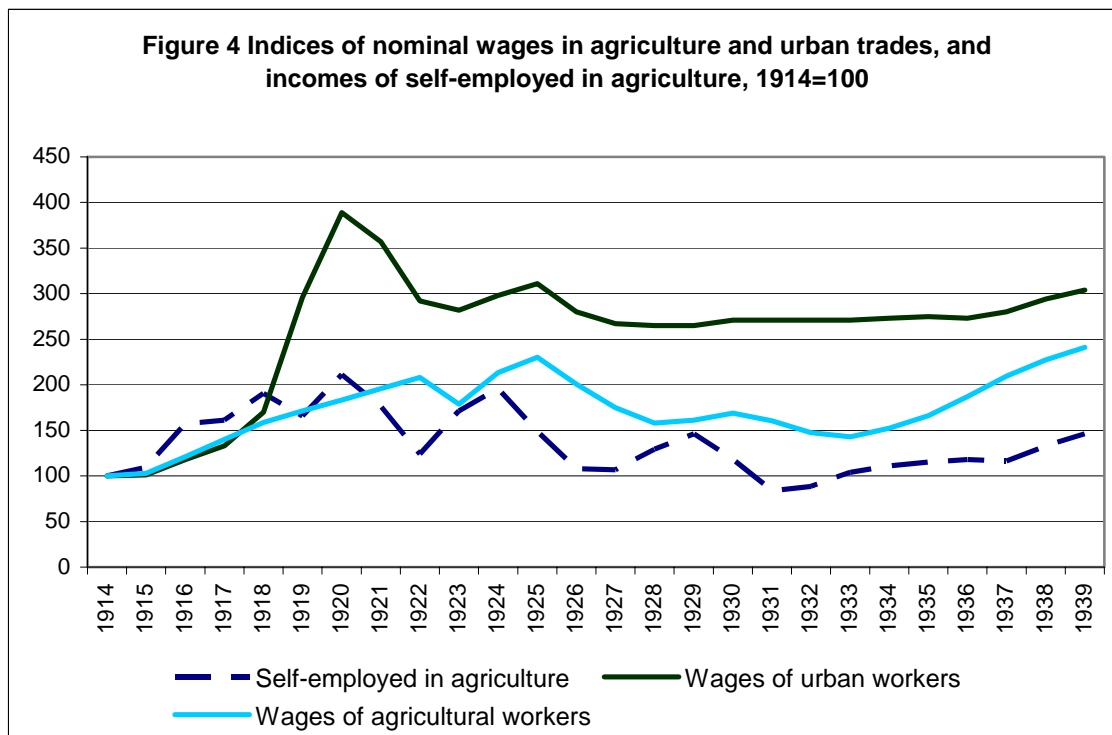
	$\Delta Y/Y$	$\Delta L/L$	Y/L
1910-21	2,42	2,19	0,22
1921-31	4,11	2,30	1,77
1931-39	2,47	1,60	0,86

Source Hansen (1984) pp. 231 and 259

3.b. Labour force and labour's reward in agriculture

Total labour force in Danish agriculture grew by 5 per cent from 1920 to 1930. It is telling, however, that the number of employees in agriculture was stagnating and declined by 4 per cent from 1921 to 1930, whereas the number of self-employed farmers and their wives increased by 9 per cent in the same decade. When we compare the development in wages between employees in agriculture and in urban trades (defined as non-agriculture) we might even have expected a stronger exodus of employees from agriculture from the end of WWI. Even more surprising, perhaps, is the finding that the development in the residual income per person, that is total income in agriculture minus total wage income in this sector, divided by the number of self-employed farmers and working wives, cannot account for this development. From 1924 it went against the self-employed, see Figure 4

Some explanations present themselves. First of all, we are dealing with a very short time span in which people had time to register the change in their economic situation and to adjust accordingly. Secondly, the poorer segment of self-employed farmers, the smallholders, supplemented their income by a wage income. According to the 1923 census 30-33 per cent of the holders of less than 3 hectares worked outside their own plot. For the holders of less than 1, 5 hectares the annual number of working days was 169 on average (*Statistiske Meddelelser* 4,78,2 1927). That is their total income was larger than the income from the farm they held.



Source Kærgård (1991) pp. 580-81, 590 and 594.

This may also be part of the explanation why smallholdings were traded at a higher price per unit of land even without buildings. The Danish economist Bjerke (1950) calculated the proportion between the annual net economic result from a holding or farm and the purchase price in the 1920s and 1930s. He found that this to be 15-16 for the farms and above 21 for smallholdings. According to him the buyers of smallholdings would include the income paid work by the family outside the holding in their calculation. A broader interpretation would be that the buyers of smallholdings set a lower price on their own labour than the buyers of middle sized and large farms.

3c. Ideology, land laws 1899-1919 and land prices

Two unfortunate claims left their mark on public debate from the turn of the century and even after WWII. The first concerned the farm structure. It was rarely contended that smaller holdings were more efficient than larger ones even at a time when labour saving technology became available to an increasing degree. Only rarely was the wisdom of further parcelling out of land cast into doubt. One of the few exceptions was a large estate owner (quoted in Pedersen 1928, p.67) who stated the obvious, that small holdings were an inefficient use of land and that the costs of this distortion were carried partly by the owners who were poorly rewarded for their efforts

and partly by the state that subsidized the parcelling out. An alternative scenario, without the active land policy of the state, might well have led to an equilibrium of higher wages in agriculture, a consolidation of land in larger holdings, and, consequently, to a more labour saving strategy on the farms.

The popularity of the parcelling out of land can probably be explained by the fact that this issue was somehow confused with the issues of social peace and social justice as if small holdings could still save families from poverty in the 20th century.

The other claim brought forward was that since agriculture was a “net exporting” sector of the economy its relative size at any time represented an efficient allocation of labour and capital. No economist would, of course, subscribe to this view.

Although the lot of agricultural workers had improved during the latter third of the nineteenth century there was, as already mentioned, a growing political interest in their living conditions towards the end of the century. The group itself was large enough to make up a non-negligible part of the electorate¹⁴ and other classes of the population also become concerned about the agrarian proletariat. It was commonly believed that the urban trades could not absorb the population surplus from agriculture and the granting of plots of land would help to keep socialist ideas at bay.

Many agricultural labourers had managed to get a smallholding before the 1890s when the 1899 act “to further acquisition of land by agricultural workers” was passed in parliament. This act extended cheap government credit (loans at 3 per cent) to labourers who had saved a little money themselves. The purpose was, rather explicitly, to retain a “suitable “number of workers in agriculture or, and to stem the movement of population from country to town which was otherwise stimulated by higher wages.

In other words the emphasis was on providing workers for large and middle-sized farms. Consequently, the size of the holdings under this act was limited to 4 hectares 12 acres, which made it obligatory for the smallholder and his family to seek employment outside the holding. Legislation after 1901, when the farmers’ liberal party (*Venstre*) took office, alleviated these conditions. The size limit was extended and removed completely in 1909 and the state loans increased accordingly. Political developments around 1900 had influenced land policy. From 1896 the smallholders had formed their own associations, in contradistinction to the older

¹⁴ The number of households in agriculture 1895 with 0-1 *Tønder hartkorn* (a measurement of fertility units), where 1 was considered the sustainable size of a family holding, was 196.000 out of a total of 271.000 holdings.

farmers' associations.¹⁵ After 1905 a political party, radical liberals (*Det Radikale Venstre*), instigated by small holders (and urban intellectuals) had eagerly argued for more plots although of a slightly larger size, big enough to support a family. Under the land acts 1899-1909 8.263 new holdings were created 1900-1920.

WWI strengthened the political movement for the subsidizing of even more plots. The higher land price in itself served as a barrier to new young buyers. Furthermore, the war had damaged smallholdings disproportionately because of their dependency upon purchased feeds. Quite a number of smallholdings, therefore, were sold and their land added to already existing farms (Jensen 1936, p.131). One act, made permanent in 1925, was to preserve smallholdings intact and restrict the sale of land from small farms.¹⁶ Another act, of 1919, was to create yet a new way for young agricultural workers to farm land of their own. Strongly influenced by the ideas of Henry George it held that every citizen had an inherent right to a share in the land. Therefore, land should be hired out, not sold. The "land rent holdings act" of 1919 resulted in 4.200 holdings during the 1920s. The land rent was calculated as the value of the holding found at the regular land valuations times the long term interest rate. The land for the holdings was acquired through a virtual expropriation of land from the large entailed estates.¹⁷ About one third came from the rectories as they fell vacant.

It soon appeared that the older principle of state loans to buy land was still the more popular and its provisions resulted in more than 11.000 holdings during the 1920s. In 1930 the formation of new smallholdings came to a halt.

2.d. Investment patterns in the 1920s

We have argued that the labour input, not least on smallholdings, is underestimated. Additional evidence is found in the pattern of investment in agriculture during the 1920s. The growth of total capital in agriculture during the 1920s was impressive albeit by no means even. If, however, we distinguish between investment in buildings & machinery and in herds & inventory¹⁸ it turns out that the latter was by far the dominant factor. The value of herds & inventory per worker in fixed

¹⁵ In 1910 these associations had 39.000 members.

¹⁶ Not until the early 1970s and Danish membership of the then EEC was land policy effectively reversed to structural reorganisation that entailed a radical decline in the number of small farms.

¹⁷ The entailed estates, in return, got the right to deal with their land as personal property in the modern capitalist sense, that means to sell and mortgage at their will.

¹⁸ "Inventory" stands for feeds.

prices grew at a higher rate than the value of machinery, unlike the period before WWI and unlike the 1930s (Kærgård 1991 pp. 510-511).

Furthermore, when we look at the type of machines acquired during this period, displayed in Table 6 below, we find more of the technology to save labour during the peak seasons but very little to lighten the daily workload. In other words investments were not obviously labour saving, particularly when we think of the higher workload connected to more animals on each farm or holding. During 1924-34 the number of cows increased by 1, 55 per cent p.a. and the number of pigs by 0, 82 per cent. To sum up the apparent success during the 1920s as far as real GDP per member of the labour force during the 1920s is bound to have been bought at the price of longer working hours.

Table 6 Selected machinery in agriculture 1923 and 1936. Per cent of all farms

Type	1923	1936
Sowing machines	41,9	62,7
Mowers	46,0	71,1
Reapers	34,1	45,5
Electric motors	20,2	36,0
Threshers	56,9	69,6
Tractors	1,0	3,3
Milking machines	0,4	1,8

Source: Official statistics quoted from Pedersen (1988, pp. 24-25)

4. Conclusion

Looking back at the two phases of growth in Danish agriculture 1870-1914 and 1914-1939 and even beyond that time it is tempting to conclude that this sector became a victim of its own initial success.

Danish agriculture was successful in meeting the challenge of the European grain invasion. From the late 1890's in particular labour productivity in agriculture rose at an unanticipated speed that compares favourably with that of most other European agrarian societies. The driving force was that of a small open economy, which responded effectively to a change in international product prices. The move from grain exports to exports of animal products, mainly butter and bacon, was

to a great extent facilitated by the spread of agricultural cooperatives. This organisation allowed the middle-sized and small farms that dominated Danish agriculture to benefit from the economy of scale in processing and marketing. No doubt the export drive of agriculture towards the end of the 19th century was a main force in developing other sectors of the economy not least transport, trade and finance, confer Table 1 below. The manufacturing industry was still relatively small and grew only slowly from the 1870's with a temporary acceleration in the late 1890s. Its export never exceeded 10 per cent of value added before 1914. In comparison agriculture's export quota was around 60 per cent, confer Figure 3.

Due to Danish neutrality during the Great War agriculture suffered neither loss of people nor destructions of land and capital. Export opportunities were ample to both sides in the conflict, but as the war went on the imports necessary to sustain a relatively large animal production were cut off from 1917. During 1919-1931 agriculture not only recovered but it returned to a steeper growth path in real GDP per capita than that of the pre-war years. Moreover, growth was higher than in the other sectors of the economy. Not even the international fall in prices 1920-22 and the results of the faulty Danish monetary policy 1925-26 provided any definite break with this trend. As a result agriculture's share of GDP in current prices remained around one fourth and its share of the labour force more than one third at the onset of the depression that reached Denmark in 1931.

This paper had taken a critical look at the Danish agricultural developments particularly during the 1920s. We do not claim that high productivity and output in agriculture without offsetting changes in relative prices squeezed out the Danish manufacturing sector (a development suggested by Matsuyama 1991). Neither wages nor GDP per capita showed a relatively more positive development in agriculture. We suggest, instead, that a strong agrarian opinion and the concomitant land policy rather than relatively high incomes served to retain labour in agriculture. The drive for parcelling out land in small holdings was reinforced by the disruption in production during WWI. Land prices had gone up and some small holdings had been dismantled due to their dependence on imported feed stuffs. Consequently, a misguided opinion after WWI bore part of the responsibility for the lacklustre performance of the Danish economy as a whole in the 1930s.

GDP per work hour in Denmark grew by an annual rate of 0.29 during 1929-1939, compared to an annual growth rate of 1.48 by the average of Maddison's 16 rich OECD countries.¹⁹

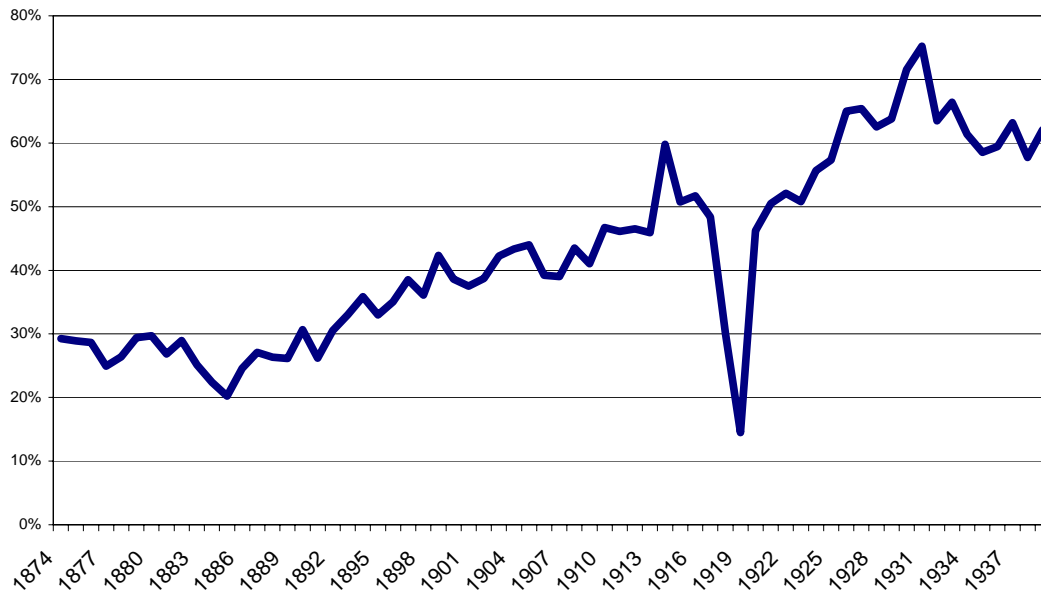
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¹⁹ Pedersen in Crafts and Toniolo (1995) p. 546. GDP is measured in 1970 US relative prices. The Danish growth rate ranks the country as number 12 among the rich countries. This compares unfavourably with the growth record during 1880-1929 when Denmark was among the 3-4 fastest growing countries.

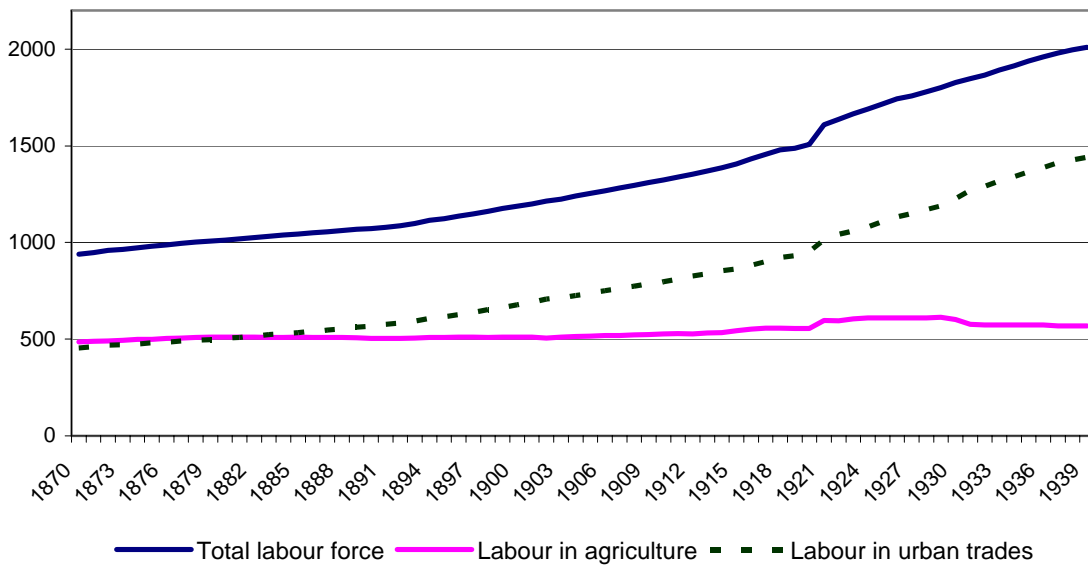
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Appendix figure 1 Net exports as per cent of GDP in agriculture

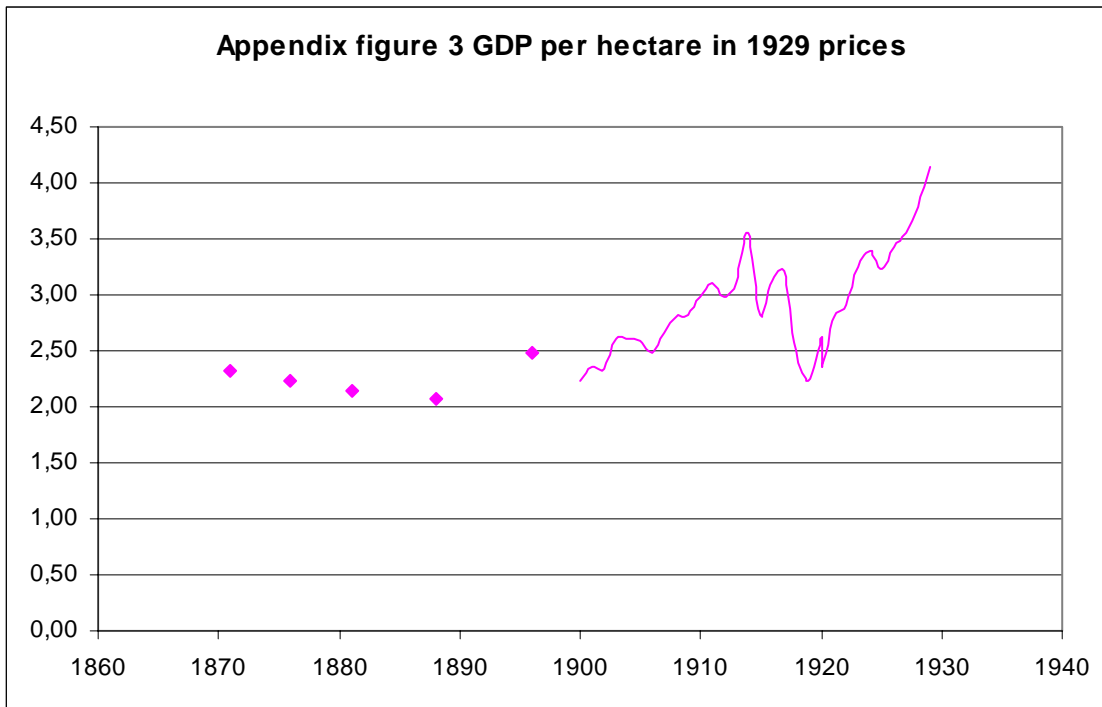


Source: Bus Henriksen and Ølgaard pp. 48-51 and Hansen (1984) p. 238-239

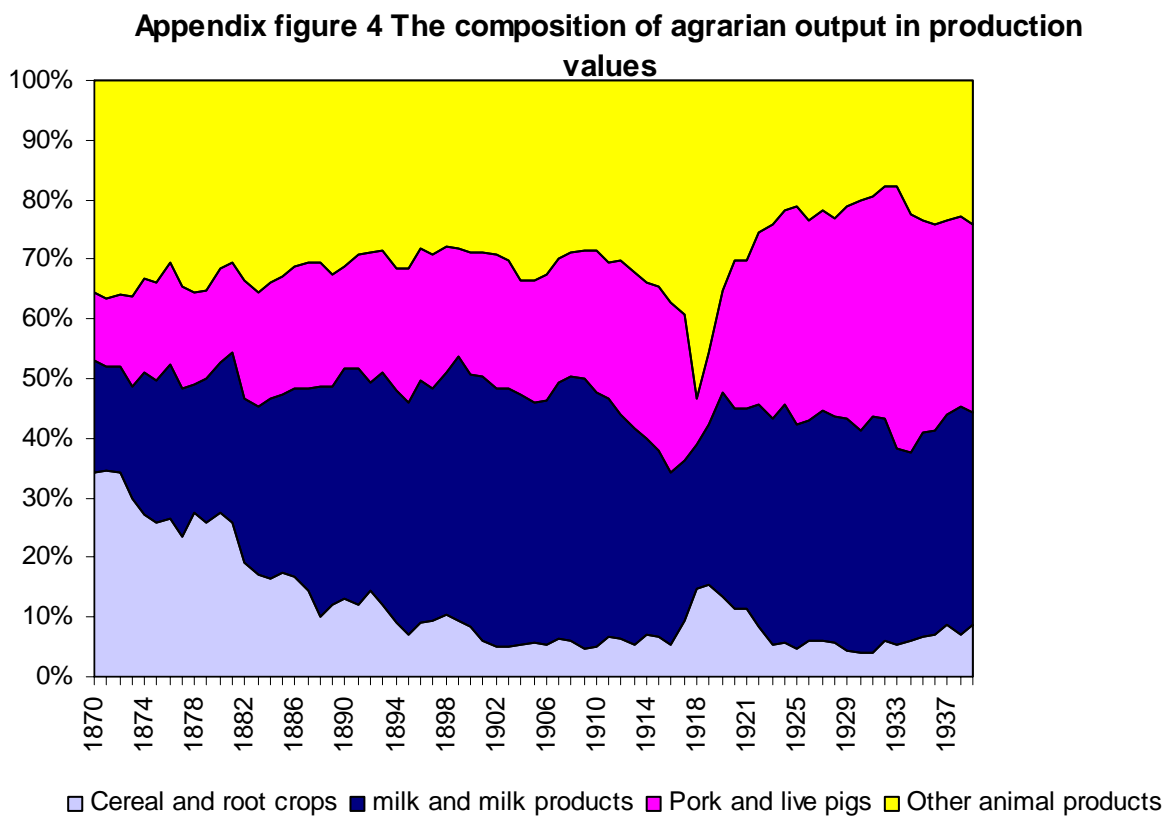
Appendix figure 2 Labour force by sector in 1000 persons



Source: Hansen (1984) pp. 229-231



Source: Johansen (1985) pp. 129-130 and Hansen (1984) pp. 250-251



Source: Hansen (1984) pp 234-235

Appendix table 1

Average annual growth in agricultural GDP (1929 prices)

Decades

1870-1879-	0,5%
1880-1889	0,2%
1890-1899-	0,2%
1900-1909	2,2%
1910-1913	1,2%
1913-1919-	5,9%
1920-1929	5,5%
1930-1939	1,8%

Peak to peak years (calculated from 3 year moving averages)

1882-1892	1,5%
1892-1896	0,7%
1896-1904	2,1%
1904-1913	1,4%
1913-1933	2,2%

1892-1913 1,6%

Maddison's phases of growth

1870-1913	3,5%
1913-1939	2,6%

Source: Hansen (1984) pp. 250-251

Appendix Table 2 An alternative calculation of the sectoral shares of agriculture and manufacturing in Denmark 1900-04 to 1935-39. Per cent of total GDP at factor costs

Year	Old data from Hansen		New Data from Nilsson	
	Agriculture	Manufacturing	Agriculture	Manufacturing
1900-04	29	20	21	25
1905-09	28	20	22	24
1910-14	28	20	23	23
1915-19	27	19	22	21
1920-24	23	21	18	24
1925-29	21	21	18	23
1930-34	17	24	15	27
1935-39	16	27	14	29

Note: Manufacturing is industry & trade plus public utilities. In the new data creameries and bacon factories are included in manufacturing. In the old data these businesses count as agriculture.

Source: Carl-Axel Nilsson: LAMEJSLA. Nye serier for landbrug og landbrugsindustri I de danske historiske nationalregnskaber 1900-1947. *Historisk Tidsskrift*, 2004, vol. 104:1 p. 235

Appendix B

A brief note on the consequences of border changes in the Danish case

In June 1920 Northern Schleswig, *Sønderjylland*, lost to Germany after the war in 1864, was reunited with Denmark. Total agricultural area increased by about 11 pct. and total population by about 5 per cent. The inclusion of this particular region tipped the balance of the Danish economy slightly in favour of more agriculture. Around 44 per cent of the population in Sønderjylland was in 1921 living from agriculture compared to around 33 for the rest of Denmark (Iversen 1933, p. 321).

Moreover, the pattern of agricultural production in Sønderjylland differed somewhat from that of the rest of Denmark. Due to high rates of emigration during the last decades of the 19th century the labour force had stagnated and even declined until around 1906-07. Consequently, agricultural production generally was less labour intensive with a larger role for cattle breeding²⁰ and a lesser one for dairy farming. The grazing area in per cent of total agricultural land increased by some 2 per cent points for all Denmark as a result reunification. In the eastern part of Sønderjylland, though, the transformation of agriculture from grain production towards dairy farming, from the early 1880s, followed very much the same pattern as in Denmark (Schultz Hansen 1985, pp. 194-196). Cooperative creameries that were to play a vital role in this transformation resembled those in Denmark.

Probably the most important effect of reunification on the Danish economy during the 1920s, although it cannot be quantified, was the necessary assistance, mainly in the form of subsidized credit, to agriculture in Sønderjylland, impoverished as it was by war and monetary collapse.

²⁰ Furthermore, the cattle farmers of North Schleswig were, of course, not affected by the German ban on imports of live cattle in 1881-82 as were their Danish colleagues.