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Title: *The Danish Agricultural Revolution in Global Perspective*

Abstract: Robert C. Allen argued convincingly in his book, *The British Industrial Revolution in Global Perspective* (Cambridge, 2008), that a critical factor for British development was the availability of cheap domestic sources of energy, in particular coal. We put the story of Danish development within the context of this debate. As is well known, Denmark did not so much industrialize but rather experienced a rapid transformation of its agricultural sector in the second half of the nineteenth century. From being a grain exporter it became a highly efficient producer of processed foods, in particular butter and bacon, which were then sent to feed the rapidly growing industrial cities of northern England. The Danish economy grew rapidly and soon reached levels of GDP per capita rivaling the richest countries in the world, a position it has since maintained. And yet Denmark had few natural energy resources: her land had been largely deforested over the preceding centuries; she had practically no coal; and she didn't even enjoy the fast flowing water which was to be so important for her fellow Scandinavian countries.

Scholars since Allen have found the lack of energy sources to be a limiting factor to growth. Was Denmark an exception? In fact, what does not seem to have been appreciated in the literature is that Danish agriculture was a large consumer of coal, which was used to fuel the machinery in the cooperative creameries and slaughterhouses. Indeed, this was not even simply incidental to the development. The automatic cream centrifuge relied absolutely on steam power from coal to function (at least until electrification in the twentieth century), a point made clear during the First World War when imports of coal were difficult, and creameries were forced to rely on locally sourced peat to run the machinery, which proved very unsatisfactory and expensive.

Allen argued for the importance of the combination of high wages and cheap coal for British industrialization. In Denmark wages were also high in a European perspective, even before the agricultural transformation. Coal was not available in Denmark, but the rapidly falling transportation costs of the late nineteenth century meant that Denmark was particularly well placed to receive cheap imports from Newcastle: both of course because of her physical proximity, but also because of her geography. Denmark is a country consisting of one peninsular and hundreds of islands. Nowhere is more than a few miles away from the coast. It was thus relatively cheap to import coal into any point in Denmark, and allowed the rapid spread of the cooperative dairy system around the country.

We provide a wealth of statistical evidence from individual creameries showing the importance of coal for production, and we demonstrate that coal was available more cheaply in Denmark than almost any other European country. Moreover, using a new database of energy consumption by source we demonstrate that coal was the major energy source behind the Danish 'agricultural revolution'. Clearly, having no domestic energy sources was in fact not necessarily a barrier to economic development, even before the age of oil and electricity.