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the Competition for the British Butter Market

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## Greasing the Wheels of Rural Transformation? Margarine and the Competition for the British Butter Market

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### Abstract

We consider an example of the impact of a new good on producers of close substitutes: the invention of margarine and its rapid introduction into the British market from the mid-1870s. This presented a challenge to the traditional suppliers of that market, butter producers from different European countries. We argue that the capacity to react quickly to the appearance of this cheap substitute by improving quality and establishing product differentiation was critical for the fortunes of butter producers. We illustrate this by discussing the different reactions to margarine and quality upgrading in Ireland, Denmark and the Netherlands. A statistical analysis using monthly data for Britain from 1881-87 confirms that margarine had a greater impact on the price of poor quality butter than that of high quality butter, presumably because it was a stronger substitute.

JEL Codes: L66, N53, O31

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# I

At the intersection of industrial organization and international trade, the *Economics of New Goods* is one of the liveliest fields of study in economics (see Breshanan and Gordon (eds. 1997)), and has largely focused on the effects of new consumption possibilities on consumer welfare and behaviour<sup>2</sup>. It is also a central topic in economic history through the idea of an ‘Industrious Revolution’, as the consequence of a desire to purchase new goods (De Vries 2008, Hersh and Voth 2009/11). What, however, seems to have been completely neglected is the impact of new goods on established producers. This study aims to be a first step in rectifying this omission through an investigation of the impact of the invention of margarine in 1869 on major butter producers. Our approach is in part motivated by a series of recent studies in the field of industrial organization which investigate the effects of new varieties on the prices of existing goods and the profits of incumbent and new producers, following a pioneering study by Hausman and Leonard (2002) on the introduction of the Kleenex Bath Tissue brand into the US toilet paper market in the early 1990s.

As a cheap new substitute for butter, margarine certainly had an impact far beyond that of any new brand of toilet paper. Focussing on the British market, we demonstrate that apart from increasing the supply of ‘spreads’<sup>3</sup>, and helping reverse a decade-long trend of increasing relative and absolute prices of butter<sup>4</sup>, the new product also had a major effect on producers, and played an important role for the transformation of an entire industry. Butter exporting countries who met the challenge by increasing quality, most spectacularly Denmark,

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<sup>2</sup> There are two main themes. The first is more oriented towards macroeconomics, and aims at estimating the additional consumer welfare from new products (the classical study is Hausman 1997; see also Hersh and Voth 2009/11). The second considers how to correct price indices to take account of these benefits (see Feenstra 1994 and Broda and Weinstein 2006).

<sup>3</sup> We call them this for convenience, although of course they were for example also used for cooking and frying.

<sup>4</sup> For the evolution of the relative prices of animal products versus grains in Britain see Henriksen, Lampe and Sharp 2012, Figure 3, and also Donnelly 1971, p. 131-132.

maintained their position on the British markets. Those that failed, for example Ireland, lost ground.

The reasons for the success of Denmark and the failure of Ireland have in fact been the subject of a long-running debate within economic history (see for example O'Rourke 2006). Much of this relates to the revolutionary changes in Danish agriculture between 1860 and 1890: first, with the emergence of factory creameries for centralizing butter production in the 1870s (Bjørn 1977), and then with the birth of the hugely successful cooperative creameries in the 1880s (Henriksen 1992, Henriksen et al 2011). While it might be impossible to fully assess the role of margarine in this process, we argue that its relative impact on butter prices acted as a catalyst, accelerating the need to transform traditional structures. The speed and depth of this adaptation then affected the relative position of the butter producers and with them important parts of their respective economies.

To give some perspective to the importance of this industry for producing countries, in 1880-84, milk and milk products accounted for about 27.5 per cent of Danish agricultural production and about 11.4 per cent of GDP<sup>5</sup>. Exports of butter were 3.4 per cent of Danish GDP in the same period, excluding an equal share of by-products like bacon as well as live cattle (Bjerke and Ussing 1958, pp. 128, 146; Hansen 1984, p. 234, 246, Henriksen, Lampe and Sharp 2012). This share was increasing rapidly to about 9 per cent in 1900 (Henriksen et al 2011, p. 490). In Ireland, butter production represented 18.7 per cent of agricultural production in 1880 (O'Rourke 2006) and butter exports represented about 3.1 per cent of GDP in 1881, but their importance was rather declining over time to about 2.1 per cent in 1901.<sup>6</sup>

From the British side, it is well known that butter was a major source of calories for workers, increasing from around 3.3 per cent of total caloric intake per person in 1863, to around 5.8 per

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<sup>5</sup> These figures do not include by-products from pig-feeding, hides, skins, etc.

<sup>6</sup> We arrived at these figures by multiplying the quantity of butter exports from Solar (1990, p. 159-160) with the average of Kennedy and Solar's (2007) prices for Irish butter (North/South), dividing them by Geary and Stark's (2002) GDP estimate for Ireland, transformed into current prices by Crafts (2005).

cent in 1889-90.<sup>7</sup> Moreover, since fats are luxury proteins, the dietary importance and the importance as a share of income must have exceeded this.

Below, we discuss the reactions of the main butter exporters to the invention of margarine, in particular through improvements in quality. We demonstrate that the prices of poorer qualities of butter were impacted on more greatly than that of better quality produce using a simple econometric analysis of the prices, and we attribute this to the fall in demand for low quality butter, as consumers substituted it for margarine. Finally, we turn briefly to the political and legislative reaction to this. Before this, however, we first look at the introduction of margarine, and its effects on the British market for spreads.

## II

Margarine was initially produced from purified beef suet or caul fat of beef known as 'oleo', flavouring, and colouring (Schrover 1990, p. 56; Miller 1989, pp. 101-102). It was invented in 1869 by the French chemist Hippolyte Mège-Mouriès, responding to a prize offered by Napoleon III. He called his new butter substitute oleo-margarine,<sup>8</sup> patented his invention in 1869, and then sold it to the Dutch company Jurgens (now part of Unilever) in 1871. The threat to butter producers was immediately apparent. When coloured, it was a very close substitute for butter, but could be produced at a fraction of the cost. Moreover, it was commonly mixed with butter itself to become 'butterine'. This was a good imitation of middle quality butter, and

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<sup>7</sup> According to Clark et al (1995, p. 223), poor working families consumed 9.1 pounds of butter per year in 1863, while in 1889/90 members of families of textile workers consumed on average 19.5 pounds and those of metal workers 24.5 pounds. The latter numbers seem to include a part of the cheese consumed, so we deduct 7.5 lbs from each number, arriving at an average of 14.5 lbs per person. At a nutritional value of 7170 kcal per kg of butter, the 1863 value is equivalent to 29600 kcal or 3.3 per cent of total caloric intake per person, and the 1889-90 estimate to 47150 kcal or 5.8 per cent of annual caloric intake.

<sup>8</sup> Snodgrass (1930), pp. 122-123; Hoffmann (1969), pp. 9-13.

indeed, before the introduction of legislation requiring it to be labelled otherwise (see Section V), was usually exported and sold as such.<sup>9</sup>

Although the first joint stock company for production of margarine in the UK was registered on 26 May 1875<sup>10</sup> (BPP 1875), much margarine was imported and, as Figure 1 demonstrates, it rapidly conquered an important share of the British import market, and much went to satisfy the demand from the rapidly expanding industrial cities of the North of England (see for example Drejer 1943), once it was ready for large-scale production.

[Figure 1 about here]

A large proportion of the imported margarine came from the Netherlands, where Jurgens and Van den Bergh, competing butter merchants based in Oss, a town with a significant inland port in Northern Brabant, had started to produce margarine in 1871 (Schrover 1990). Figure 2 shows the boom in production of margarine in the Netherlands.

[Figure 2 about here]

Since oleomargarine was produced largely from beef, it was in part a by-product of dairying. However, dairy producers in Europe did not gain from this, since it was largely supplied by

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<sup>9</sup> Subsequently, porcine lard was also used for margarine production, but the use of vegetable oils was very limited before the development of fat hardening processes in 1902 (see Snodgrass 1930, pp. 138-141; Hoffmann 1969, p. 16).

<sup>10</sup> Company registered for 'The manufacture of margarine, stearine, or other fatty substances on premises lately belonging to the Continental and Shipping Butter Company (Limited)'.

producers in the US, particularly New York and Chicago. Although the margarine produced there was mostly consumed on the domestic market, the ingredient oleo was mostly exported to the Netherlands, from which it was re-exported as margarine (see for example 'Mælkeribrev fra Amerika', *Ugeskrift for Landmænd* 1880, 5:9, pp. 563-566<sup>11</sup>). As manufacturing processes improved, and the quantity produced increased, the price of margarine fell rapidly compared to the general price level in the late nineteenth century, as shown in Figure 3, thus making it a more and more serious competitor to butter.

[Figure 3 about here]

The ways in which the main competitors for the British market reacted to this challenge were to shape their relative fortunes for the next few decades. While the quantity of spreads imported into Great Britain more than doubled between 1865 and 1890, from around 1.75 million to over 3.5 million cwt.,<sup>12</sup> only about half that increase consisted of 'butterine', which by 1890 made up around 30 per cent of the imports of spreads. The remainder was butter, for which the market shares of the different supplying countries shifted remarkably. We argue that the corresponding changes in the fortunes of butter producers were related to the rise of margarine, whose role as a competitor to and substitute for butter had a far from uniform impact on butter exporters. As Figure 1 demonstrates, the market share for some countries, particularly Denmark, expanded rapidly, from 3.8 per cent of the market for butter to 31.7 per cent, corresponding to 22.4 per cent of the market for spreads. The losers were in particular Ireland, whose share shrank from 37.8 per cent in 1865 to just 22 per cent of butter and 15 per

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<sup>11</sup> The Danish journal *Ugeskrift for Landmænd* in the 1870s and 1880s, while clearly noting in various reports the presence of and danger presented by margarine, is especially concerned with the production in the US, and notes that the reputation of American butter producers was suffering due to this.

<sup>12</sup> See also O'Rourke (2006), p. 169. At the same time, the population of Great Britain 'only' increased by about a quarter (Maddison 2007).

cent of spreads imports. In fact, the amount of butter exported from Ireland in 1890 was some 13 per cent below the 1865 level. The Netherlands also saw a large fall in relative and absolute terms, but this was more than made up for by her exports of margarine, which dominated that market.<sup>13</sup>

### III

To understand the differing fortunes of butter exporters, we focus here on three large suppliers to the British market in the 1880s: Denmark, Ireland, and the Netherlands. We mostly ignore the case of France. Although already in 1870 fresh, lightly salted butter from Normandy had completely ousted the otherwise dominant Irish competitor in London (Donnelly 1971), this was a different product to the butter that otherwise dominated the market, and it was to be far less affected by the rise of margarine than the standard butter types.<sup>14</sup> In fact, the solution to the competition from margarine was to differentiate from it as much as possible.

Ireland was the traditional supplier of butter to Britain, as is apparent from Figure 1. In all years before 1860, Irish producers had supplied more than 50 per cent of British butter imports; subsequently, they failed to increase butter exports in absolute terms despite an expanding market. Many explanations have been given for the failure of the Irish butter industry at the end of the nineteenth century, particularly in comparison with the Danish example (see for example Ó Gráda 1977 and O'Rourke 2006, 2007). One side of this was a signal failure to increase quality. In fact, not only could Irish producers not compete with Danish butter in terms of quality, but neither could they compete with margarine in terms of price. Quantifying this

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<sup>13</sup> Nevertheless, within the Netherlands, butter and margarine producers were not closely related and actually located in different areas, as mentioned below.

<sup>14</sup> Moreover, there was a clear tendency on the British market towards quality premia for fresher and lighter salted foods at least since the 1870s, also for products such as milk (normally British supplied, but also from Normandy), cream, pork or beef (French and Philips 2000, pp. 96-97). However, fresh butter required a wealthy local market, and was thus not a viable alternative for most producers.

failure to increase average quality is unfortunately not easy, although the figures in Table 1 might be indicative. Here we show the quality distribution of the different classes of butter traded via the Cork Butter Market in 1877-78, in October 1881 and in October 1883, the only quantity data we could get hold of.

**Table 1: Volumes of various qualities of the butter traded on the Cork Butter Market**

Class	1877-78		Oct 28, 1881		Oct 2, 1883	
	Firkins	%	Firkins	%	Firkins	%
1 <sup>st</sup>	135044	31.1	897	40.6	302	43.6
2 <sup>nd</sup>	181608	41.8	989	44.8	122	17.6
3 <sup>rd</sup>	102961	23.7	294	13.3	77	11.1
4 <sup>th</sup>	13537	3.1	25	1.1	12	1.7
5 <sup>th</sup>	1153	0.3	3	0.1	0	0.0
6 <sup>th</sup> <sup>15</sup>	55	0.0	0	0.0	0	0.0
Superfine					124	17.9
Fine mild					50	7.2
Mild					5	0.7

**Sources:** Sheldon (1886), 359; *Freeman's Journal and Daily Commercial Advertiser*, "The Irish Butter Manufacture. To the Editor of the Freeman," 4 November 1881; Cork City and County Archive Website, "Butter Inspection Slip, 1883", <http://www.corkarchives.ie/merchantcity/home/provisionstrade/butterinspectionslip1883/>.

According to O'Donovan (1940, pp. 311-312) only the first three qualities were actually fit for human consumption, and we see the others were of tiny and declining importance. Among the

<sup>15</sup> The worst quality butter on the Cork Market was also known as a 'bishop', the reason for which is unclear. C.B. Gibson (1861, p. 379) recounts an episode illustrating unintended consequences of this:

*Bishop Brinkley, of Cloyne, wandered one morning into the Cork Butter Market, and inquired of one of the porters, to whom he was unknown, respecting the various classes of butter. "What do you call the best?" inquired Brinkley. "The first quality, your honor." "And the worst?" "The worst, your honor, is a bishop." "A bishop," said Brinkley, in surprise. "Now, may I ask you, my good fellow, why you call the worst a bishop?" "Bekase, your honor, a bishop is the very worst quality." "I see," said Brinkley, walking off.*

better qualities, we see a clear shift from lower to higher qualities in a very short period of time. Furthermore, for the 1880s, we find mentions of Cork 3<sup>rd</sup>s in British Newspapers mostly in the context of purchases for hospitals, workhouses, etc., and not so much for the regular market. It seems that due to the large amount of salt in them they were both durable and at the lower bound of being edible.<sup>16</sup> For 4<sup>th</sup> quality butter, the *Freeman's Journal and Daily Commercial Advertiser* reported on May 6, 1880 on a lecture by Rev. Canon Bagot, who had actually compared a similar quality in a butter shop in Dublin to what he called 'bosh' – the description of which is similar to that of butterine – finding that the first was inedible and the second not, although both commanded similar prices.<sup>17</sup>

Weighing the quantities reported in Table 1 by their prices, it can be seen that the average quality is increasing from 87 to 95 per cent of the price of Cork 1<sup>st</sup>s between 1877-78 and October 1881. In addition to this, the author of our source for the 1881 data recounts that there were also fine and superfine qualities traded in Cork, although not in large quantities. For October 1883, we can quantify this, and see that the average quality is now, including the milder, less salty varieties of superfine, fine mild and mild, 99.5 per cent of Cork 1<sup>st</sup> and 92.5 per cent of Cork superfine prices. The fact that superfine quality accounts for 17.9 per cent of all firkins, and another 43.6 per cent are Cork 1<sup>st</sup>s, can be compared to Danish butter (which we discuss in detail below), of which the quality sold in London according to the author of our 1881 data source was actually “uniformly ‘superfine’”. So, despite the quality improvement, Irish butter still lagged considerably behind its Danish counterpart. We can show this by comparing the average quality of Irish butter to that of Danish butter on the London Provision Market. According to this, in October 1881 the average Irish butter price for the varieties given in Table 1 was 74 per cent of the Danish top price, two years later, and including superfine varieties, it

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<sup>16</sup> See the *Bristol Mercury and Daily Post*, 3 October 1888; *Preston Guardian*, 28 March 1885; see also BPP (1881, C.2778, p. 360-62) and BPP (1881, C.3096, pp. 57, 67), both reporting evidence collected by Her Majesty's Commissioners on Agriculture.

<sup>17</sup> *Freeman's Journal and Daily Commercial Advertiser*, “Canon Bagot on Butter-Making. (From our Reporter),” Dublin, 8 May 1880.

was 75 per cent of the best Danish price, so that, despite improvements in the average quality of Cork butter no ground was won in comparison to Danish butter. As a reference for comparison, for the whole of 1881 the average unit value of Danish butter imported into Britain reported in British trade statistics was 86 per cent of the average quotation of best Danish butter on the London provision market; this increased rapidly to 94 per cent in 1882 and 1883.<sup>18</sup> In short, Danish style improvements proved difficult to implement in Ireland, both regarding innovations in production and in marketing (see Donnelly 1971, p. 154-162, for the important Cork butter market), with the result that the average quality of the Irish product mix responded much slower to the new challenges and therefore in the 1880s and 1890s remained clearly below that of Denmark (O'Rourke 2006; Higgins and Mordhorst 2008, p. 100).

Another exporter of historical significance was the Netherlands. Until the 1870s, Dutch butter enjoyed a good reputation on the British market. However, as the demand for butter increased, so too did the incentives for the individual farmer to tamper with it, in order to free ride on the good reputation of the others, in later years particularly by mixing it with margarine. The upshot of this was that as other countries started entering the market with good quality products, the reputation of Dutch produce began to suffer, and this was quickly reflected in the prices received. On the Leeuwarden market, the price of butter dropped by 21 per cent from 57 guilders per vierendeel<sup>19</sup> in 1871/80 to 45 guilders in 1886/95 (Bieleman 1996, p. 27; see also Van Stuyvenberg 1969, pp. 297-298, and Higgins and Mordhorst 2008, pp. 194-195). On the London market, prices for best Friesland butter fell by 21.4 per cent between 1881 and 1886/7 (see Table 4 below), although they recovered somewhat subsequently.

The problems of Dutch butter producers went far beyond the price fall, however, which was in fact a general phenomenon for butter producers as the supply expanded, since they also rapidly

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<sup>18</sup> For 1877-78, the comparison is more difficult, since for the autumn of 1877 we lack price quotations of Danish butter in London. In December 1877 and June 1878, the highest quotation for Danish exceeded Cork 1sts by around 15 per cent, which implies that the average Irish butter price was again around 76 per cent of best Danish.

<sup>19</sup> 1 vierendeel = 0.787 cwt = 40kg.

lost market share during the 1880s, in particular to Danish producers.<sup>20</sup> Eventually, the sort of innovations that the Danish introduced in the early 1880s, in particular cooperative creameries, were introduced in the Netherlands, but only with a long lag – although the first cooperative creamery in the Netherlands was founded in 1886, they only became prevalent in Friesland in the 1890s (Bieleman 1996, p. 28). In other regions less associated traditionally with butter exports, farmers attempted to apply new techniques in order to escape the declining prices, but were frustrated by inadequate distribution networks (Bieleman 1996, p. 31).

The country which benefited most from the collapse of the market share of the Dutch and Irish butter producers was Denmark. In fact, Denmark had a long tradition of exporting its finest quality butter to Britain, although it took some time before direct trading routes were established. Early attempts at export came with government supported attempts in the 1850s to establish a steamship route from northern Jutland with *Dampskibet Jylland*, although this only lasted from 1851-55 (Drejer 1925-33, pp. 312-4). During the 1860s high quality Danish ‘estate butter’ made its name on the British market (Thomsen et al 1966, p. 134). It was usually exported via Hamburg and marked ‘Kiel’ or ‘Hamburg’, and sold with Schleswig and Holstein butter on the English market as ‘Kieler-butter’ (Thomsen et al 1966, p. 169). This continued until the Second Schleswig War of 1864, in which Denmark lost the Duchies of Schleswig and Holstein to Prussia. Alternative export points were then sought, ending finally in the opening of Esbjerg harbour in 1874, at which point regular steamships left for the UK. Danish butter rapidly earned the preference of the British consumers. By 1872 Danish export butter commanded higher prices than Irish, by 1878 higher than Dutch, and in 1879 it was declared the finest in the world at an exhibition in London (Thomsen et al 1966, p. 145). Reflecting this, Danish butter received the highest prices in Britain, with the exception sometimes of the aforementioned fresh unsalted butter from Normandy (Faber 1893, 1901).

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<sup>20</sup> See Table 5 below: between 1881 to 1886 British butter imports from the Netherlands declined by 13.4 per cent per year.

However, while estate butter enjoyed export success in the UK, its peasant-produced counterpart did not, reflecting perhaps an example of the ‘Washington apples’ effect.<sup>21</sup> Peasant butter was routinely sold at a heavy discount compared to its competitor from the large estates (Faber 1918, Drejer 1925-33). Attempts to improve the quality of peasant butter are already apparent from the 1870s with the take-off of private creameries (Bjørn 1977). But its fortune was only truly reversed with the invention of the automatic cream separator in 1878 and soon after the cooperative form of production, and from this point peasant butter started to be exported in a big way (Henriksen et al 2011). The price differential between estate and peasant butter, which had been substantial, first narrowed and then disappeared (Thomsen et al 1966, p. 144).<sup>22</sup> Figure 4 illustrates the increase in the quality of Danish butter using the ratio between the average and best prices reported. Poorer qualities of butter completely disappeared during the 1890s, and were replaced by imported butter for baking and margarine for household use (Bjørn 1982, p. 124).

[Figure 4 about here]

We cannot say with any great certainty that margarine provided the incentive for Danish butter producers to increase the quality of their produce, although the increase from the late 1870s is particularly notable. The lively Danish agricultural press<sup>23</sup> reported frequently on developments

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<sup>21</sup> The ‘Washington Apples’ effect, also known as ‘Alchian-Allen conjecture’, states that because of fixed per unit transport costs the composition of varieties of the same good in export markets (e.g., Indiana for apples in the US) is biased towards high-quality varieties in comparison to the producer markets (Washington, in this example). See Alchian and Allen (1964), Bauman (2004), Hummels and Skiba (2004).

<sup>22</sup> Eventually estate butter suffered the same fate as its peasant counterpart, as the quantity and quality of cooperative produced butter increased, it too suffered from being available in too small quantities of unreliable quality after around 1900 (Faber 1918, p. 44).

<sup>23</sup> Which comprised two and from the 1880s three agricultural periodicals.

abroad, and was clearly concerned with the potential impact of margarine, and writers displayed an understanding of the steps necessary to preserve the good name of Danish produce. For example, the prominent Danish agriculturalist, Edward Tesdorpf, noted in an address to the Royal Agricultural Society of Denmark on 5 April 1882 that although margarine had a negative impact on butter prices, the effect was less for top quality Danish produce (Tesdorpf 1882, p. 193).

This is not the only contemporary account that provides some sense that margarine was one of the more important factors giving an incentive to improve quality. One of the earliest mentions comes from the United States, where a Committee of Congress in 1880 put forward the idea that margarine might promote better quality butter, stating that 'it will prevent the manufacture of thousands of pounds of bad butter now made, and encourage the making of first-class butter, and thus be a blessing to the dairymen, and that its price is essentially a blessing to the poor.' (BPP 1880, p. 445) In the context of the British market, although the usual story is that Irish butter was outcompeted by high quality Danish produce (Donnelly 1971, Ó Gráda 1977, Henriksen & O'Rourke 2005, O'Rourke 2006), many contemporaries believed that it was in fact margarine which was responsible. For example, a report from a British parliamentary select committee in 1885, declared that:

“As a matter of fact, Irish butter can only be sold now, with very great difficulty, in a few of the manufacturing districts of England, and the area of its consumption is becoming more limited every year. Its competition now is rather with the produce of the butterine factories, than with the butter shipped from France, Denmark, Germany, and Sweden. Butterine has realized a higher price in the English and Dublin markets for the past twelve months than secondary grades of Irish butter, and the bulk of Irish butter, unfortunately, is of secondary quality.” (BPP 1884-85, p. 728)

A further reference to bad quality butter being outcompeted by margarine is given in BPP (1896, p. 278), and a negative angle is put on the story by McAlpine (1886, p. 17). Similar ideas were expressed in the leading Danish agricultural journal, *Tidsskrift for Landøkonomi*:

“In earlier reports it has been suggested that the commoner butter qualities must sooner or later be outcompeted by the superior artificial butter production, which must necessarily take a large share of the market. The aforementioned annual report for the butter market in Newcastle confirms that this point in time has already been reached. The following statement in this summary of the year is revealing: ‘The lower grades of butter – previously sold under the name peasant butter – have disappeared from our market, and likewise it is extremely difficult to realize the prices, which were noted 8 to 10 years ago for best Danish quality, the reason being that the value of these goods is being checked and moderated by the finest qualities of artificial butter. In other words, artificial butter has become the factor, far more than the export of butter from other countries, that regulates the Danish market. After this, the report describes how Danish butter’s good reputation as the genuine non-blended article gives it a fortunate position when competing with artificial butter, while the butter production of other countries is already completely squeezed by artificial butter.’” (Sonne 1885, p. 63, our translation).

#### IV

So, by the early 1880s, the dominance of Danish butter on the British market was established, both in terms of quality and quantity imported, a position that was maintained until the First World War. Other countries, which were not so successful in differentiating their product from margarine, lost market share. In order to quantify the role of margarine for this, we collected high frequency price data for the rapid period of transformation in the 1880s. It is noticeable that margarine was cheaper than any edible quality of butter, as Table 2 demonstrates.

**Table 2: Average prices of butter and butterine 1881-1887**

	Shillings per cwt
Danish (Manchester)	134
Danish (London)	130
Kiel (Manchester)	128
Normandy (London)	125
Friesland (London)	117
Cork 1 <sup>st</sup>	116
Cork 2 <sup>nd</sup>	106
Cork 3 <sup>rd</sup>	88
Butterine	79
Cork 4 <sup>th</sup>	68
Cork 5 <sup>th</sup>	53

**Sources:** See text.

**Note:** We calculate the annual average prices as calendar year means of the last monthly quotations for February, April, June, August, October and December (cf. Klovland and Solar 2011). Cork 5<sup>th</sup> was not quoted after April 1886.

Our price data are monthly wholesale prices between January 1881 and June 1887. This period is partly determined by the availability of margarine price data, but it also makes sense in other ways. Before 1880, margarine only accounted for less than 10 per cent of imports of spreads, while in 1881 that share had risen to an economically significant 17 per cent (see Figure 1). Margarine imports and market shares continued to increase until 1887 (38 per cent), after which they levelled off or even declined in relative terms, possibly due to an increasing domestic production of margarine (which is difficult to measure) and some effect of the 1887 Margarine Act. The period 1880/81 to 1887 can thus be understood as the most violent and unregulated phase of the ‘margarine invasion’, since the British 1887 Margarine Act entered into force in 1888 only, while the Sale of Food and Drugs Act (SFDA) of 1875 was mostly aimed at adulteration and fraud by retailers, not by producers or wholesale merchants, who convinced legislators that adulteration originated mostly in retailing, not in previous stages of

production and distribution.<sup>24</sup> So, while there must have been significant uncertainty among consumers about whether butter was really butter, these information asymmetries should have been much less important among the professional butter traders our price information comes from. This, of course, will also make it more difficult for us to assess the impact on Dutch butter, since best quality Friesland butter quoted on the London market probably escaped in part from the uncertainties surrounding Dutch butter and margarine referred to above.

For butterine, our source is additional evidence handed in by Thomas Pearson, the manager of the butter department of the Co-operative Wholesale Society of Manchester to the Select Committee on the Butter Substitutes Bill (BPP 1887 (208), pp. 144-146). The Cooperative Wholesale Society of Manchester was one of the biggest exporters of superior quality Irish butter, shipping over £250,000 worth from Cork in 1882-83, almost 20 per cent of market receipts (Donnelly 1971, p. 144). It was also a significant purchaser and re-seller of all other kinds of import butter.<sup>25</sup> Butterine accounted for only about 1 per cent of the volume of butter sales of the company (BPP 1887 (208), p. 112), but the prices reported by Pearson are the only high-frequency series we have been able to uncover for margarine in this early period. The data we use also have the advantage of being consistent over time regarding quality. All prices he reports refer to best quality butter and butterine, respectively. Apart from the butterine prices, we also use the prices he reported for Danish and Kiel butter, which we label as '(Manchester)'. In addition we use prices from the London Provisions Market for 'Danish and Kiel' (sometimes also including Swedish), and Normandy, each time taking the month-end quotation for best quality. For Danish and Friesland, this data was kindly provided by Jan Tore Klovland (see Klovland 1993); for Normandy, we collected the data from British newspapers.<sup>26</sup> From these

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<sup>24</sup> French and Philips (2000), pp. 37-38, interpret the SFDA 1875 as an example of business capture of regulation by producers and wholesalers.

<sup>25</sup> The minutes of evidence of the Select Committee record Pearson stating that his company was "the largest, I suppose, in the world" when asked about their position as a butter purchaser (BPP 1887 (208), p. 112).

<sup>26</sup> The "Commercial Intelligence" Section of the *Manchester Times* from 1881 to May 1885, the "Monetary and Commercial/Money and Trade" section of the *Bristol Mercury and Daily Post* from June 1885 to December 1886

same sources we also collected the prices for Cork butter of 1<sup>st</sup> to 5<sup>th</sup> quality. Pearson also reports prices for Cork butter from Ireland, but he does not report data for the winter months (when markets were thin and only ‘stored’ butter was on the market), and moreover he only gives prices for the top quality. The Cork prices we use, which involve occasional interpolations for 1<sup>st</sup> and 5<sup>th</sup> quality in certain months<sup>27</sup>, in general move very similar to Pearson’s. A selection of our data is given in Figure 5.

[Figure 5 about here]

Regarding research design and expectations, some studies which seem particularly related to ours deal with the impact of private labels (or store brands) on the price and market share of national brands. These generally find that this is accompanied by increasing prices for competing national brands due to reactions like quality upgrading, product differentiation, and retailers ‘targeting’ national brands by increasing their prices and placing competing store brand items next to leading brands (Ward et al 2002, Bonfrer and Chintagunta 2004, Pauwels and Srinivasan 2004, Bontemps et al 2005, Bontemps et al 2008).<sup>28</sup> It seems likely that the

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and the “Commercial Intelligence” section of the *Freeman's Journal and Daily Commercial Advertiser* (Dublin) from January to July 1887.

<sup>27</sup> The following prices were linearly interpolated due to missing observations: Kiel (Manchester): 1881:11, 1881:12; Cork 1st (Cork): 1882:01, 1882:02, 1883:01, 1883:02, 1884:01, 1884:02, 1884:03, 1885:01, 1885:02, 1885:03, 1886:01, 1886:02, 1887:01.

<sup>28</sup> In the short run, however, when store brands were first introduced in the 1970s, they were ‘a cheap and nasty generic substitute for the real thing’ (The Economist, “Make it your own”, 4 March 1995, p. 8, cited by Ward et al (2002), note 2) and probably had a negative effect on both market share and the price of incumbent national brands (see Ward et al 2002 and Putsis 1997). Similarly, Bergman and Rudholm (2003) find that the entry of generics and potential competition lowered prices of branded pharmaceuticals in Sweden with data for 1972 to 1996.

introduction of margarine would have had similar effects: a negative effect on butter prices, but an incentive to greater differentiation and improvements in quality for butter producers.

Using our prices, we thus seek to document more formally the differential impact of the invention of margarine on the different butter producers. Ideally, we would like to examine cross-price elasticities, and look for which varieties of butter were closest substitutes. Indeed, contemporaries noted that periods of high butter prices were the ones where people substituted to margarine (see for example Otto Mønsted 1933, p. 59 for the story in Denmark, and Wiest 1916, pp. 206-8 who concludes the same for the United States)<sup>29</sup>. We do not, however, have the consumption/production data we need<sup>30</sup>.

Thus, in order to test the hypothesis that poorer quality butter was affected to a greater extent than better qualities by the arrival of margarine, we estimate simple multivariate error correction models of various butter prices on the monthly wholesale margarine prices described above, for the period January 1881 to June 1887. The elasticity of butter with respect to margarine prices then gives an estimate of the responsiveness of the various qualities with respect to the fall in margarine prices over this period. We can then compare the proportion of the change in butter prices due to margarine out of the total observed change in prices. We would expect this to be larger for poorer qualities if our hypothesis is correct.

Our econometric approach is inspired by the market integration literature (see for example Ejrnaes and Persson 2000, 2010), and at the most basic level reflects the responsiveness of each segment of the butter market to changes in the price of margarine, in this case its downward trend over time. We stress here that an underlying assumption of this approach is that markets were spatially integrated, so we are not testing for market integration in the usual sense. This assumption, however, should not be problematic, as both evidence on the spatial integration of

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<sup>29</sup> Pioneers in investigating this relationship were Wiest (1916) and Pabst (1937) for the American market.

<sup>30</sup> An obvious place to look seems to be the British trade statistics, but butterine/margarine was not separated from butter until 1885.

the British market (see, e.g., Uebele 2011 for wheat) and the practice of quoting London, Cork and other prices in daily newspapers all over the United Kingdom, shows.

We estimated the following vector error correction model by maximum likelihood using PcGive 13<sup>31</sup>:

$$\begin{pmatrix} \Delta p_t^B \\ \Delta p_t^M \end{pmatrix} = \begin{pmatrix} \alpha^B \\ \alpha^M \end{pmatrix} (\beta p_{t-1}^M - \lambda) + \begin{pmatrix} \varepsilon_t^B \\ \varepsilon_t^M \end{pmatrix}$$

where  $p_t^B$  and  $p_t^M$  are the logarithms to the prices of butter and margarine respectively,  $\alpha^B$  and  $\alpha^M$  describe the speed of adjustment (error correction) to the cointegrating relationship  $(1 - \beta p_{t-1}^M - \lambda)$ ,  $\beta$  gives the cointegrating relationship between the prices of butter and margarine, and  $\lambda$  is a constant. The residuals  $\varepsilon_t^B$  and  $\varepsilon_t^M$  are assumed to be iid. normally distributed (the misspecification tests are reported in the appendix). In each case we included two lags and a full set of centred seasonal (monthly) dummies. The results are given in Table 3. Here we have also reported the Johansen test for cointegration ( $H_0: r=1$ ), which always suggested a rank of 1, i.e. one cointegrating vector, except in the case of (2), where we accept the hypothesis that there was no cointegration ( $r=0$ ).

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<sup>31</sup> Doornik, J.A. and D.F. Hendry (2009). *PcGive 13*. London: Timberlake Consultants Ltd.

**Table 3: Error Correction Estimates for Butter Prices on Margarine Prices**

	HIGHER QUALITY							
	(1)		(2)		(3)		(4)	
	Danish		Danish <sup>32</sup>		Kiel		Normandy	
	(Manchester)		(London)		(Manchester)		(London)	
	$\Delta P_B$	$\Delta P_M$	$\Delta P_B$	$\Delta P_M$	$\Delta P_B$	$\Delta P_M$	$\Delta P_B$	$\Delta P_M$
$\alpha$	-0.78***	-0.05	-0.57 <sup>+</sup>	0.12 <sup>+</sup>	-0.59***	0.10	-0.56***	0.23
	(0.16)	(0.19)	(0.15)	(0.12)	(0.14)	(0.15)	(0.13)	(0.15)
$\beta$	-0.13***		-0.20 <sup>+</sup>		-0.14 <sup>+</sup>		-0.23***	
	(0.05)		(0.10)		(0.08)		(0.08)	
Constant	-4.43***		-4.11 <sup>+</sup>		-4.33***		-3.85***	
	(0.24)		(0.46)		(0.34)		(0.34)	
Trend	0.00***		0.00 <sup>+</sup>		0.00***		0.00***	
	(0.00)		(0.00)		(0.00)		(0.00)	
Seasonal dummies	YES		YES		YES		YES	
Log-likelihood	288.89		259.19		280.08		287.29	
H <sub>0</sub> : r=1	0.56		0.57 (r=0 accepted)		0.55		0.56	
N	78		78		78		78	
	LOWER QUALITY							
	(5)		(6)		(7)		(8)	
	Friesland		Cork 1 <sup>st</sup>		Cork 2 <sup>nd</sup>		Cork 3 <sup>rd</sup>	
	(London)		(Cork)		(Cork)		(Cork)	
	$\Delta P_B$	$\Delta P_M$	$\Delta P_B$	$\Delta P_M$	$\Delta P_B$	$\Delta P_M$	$\Delta P_B$	$\Delta P_M$
$\alpha$	-0.61***	0.15***	-0.54***	0.21***	-0.35***	0.28***	-0.30***	0.18***
	(0.13)	(0.07)	(0.14)	(0.09)	(0.13)	(0.06)	(0.11)	(0.04)
$\beta$	-0.38***		-0.40***		-0.48***		-0.47***	
	(0.14)		(0.12)		(0.13)		(0.20)	
H <sub>0</sub> : $\beta = 0.13$ (t-value)	1.79 <sup>(*)</sup>		2.25 <sup>(**)</sup>		2.69 <sup>(***)</sup>		1.7 <sup>(*)</sup>	
Constant	-3.18***		-3.09***		-2.64***		-2.53***	
	(0.62)		(0.54)		(0.60)		(0.92)	
Trend	0.00***		0.00***		0.00***		0.00***	
	(0.00)		(0.00)		(0.00)		(0.00)	
Seasonal dummies	YES		YES		YES		YES	
Log-likelihood	235.12		244.48		235.26		221.48	
H <sub>0</sub> : r=1 (p-value)	0.58		0.54		0.45		0.33	
N	78		78		78		78	

Standard errors in parentheses; \*\*\* significant at 1%; \*\* significant at 5%; \* significant at 10%; + no cointegration

<sup>32</sup> These are actually the prices of butter from Denmark and Kiel (from the former Danish Duchy of Holstein in Northern Germany).

The error correction (adjustment) coefficient,  $\alpha$ , must be negative and significant to indicate error correction (i.e. that one variable adjusts to the other). In each case the (Granger) causality runs most clearly from the price of margarine to the price of butter, as is apparent because the adjustment coefficient on  $p_t^M$  is insignificant and/or small, while that on  $p_t^B$  is significant and large, thus implying that butter prices adjust mostly to margarine prices, but not the reverse. This is less clear for the poorer qualities of Cork butter (regressions 7 and 8), which only serves to emphasize the point that the markets for the poorest quality butter and margarine were more closely linked.

The trend allows for a fall in the price of butter which is independent of the price of margarine, probably capturing overall falling price levels in the 1880s (see figure 3). Although significant, it is very small. The constant allows for non-zero trading costs. It should thus be larger for more distant markets, where transportation costs are more important, and it of course also allows for the consumers' perceived quality differential between butter and margarine, which would be reflected in a premium to butter. A negative coefficient implies a positive constant premium of butter over margarine, and in fact the price gap is larger for the better than for the poorer qualities.

The most important coefficient is  $\beta$ , which describes the equilibrium relationship. It is expected to be negative (implying a positive relationship), reflecting our interpretation that both varieties were substitutes since a price increase/decrease in one of them would be accompanied by a similar price movement in the other variety: as margarine prices fell, consumers substituted butter for margarine, lowering the demand for butter. As expected, the effect of changes in the price of margarine was greater for the lower quality types of butter. So while a one per cent decrease in the price of margarine would only lead to a 0.13 per cent fall in the price of Danish butter in Manchester (or apparently no effect on the price of Danish butter in London, since we do not find cointegration for this relationship), that of Cork 3<sup>rd</sup>s would fall by almost 0.5 per cent. In general, the elasticity for high quality butters (1-4) is about half or less that of the low

quality butters (5-8). Table 4 presents the size of the margarine effect on butter prices as a proportion of the total observed change in prices.

**Table 4: Percentage changes in prices of butter and margarine 1881-1887**

	Danish (L)	Danish (M)	Kiel	Normandy	Friesland	Cork 1 <sup>st</sup>	Cork 2 <sup>nd</sup>	Cork 3 <sup>rd</sup>	Butterine
Estimated elasticity	-0.13	0.00	-0.14	-0.23	-0.38	-0.40	-0.48	-0.47	N/A
% change from margarine	-2.2%	0.0%	-2.4%	-4.0%	-6.5%	-6.9%	-8.3%	-8.1%	N/A
% change from other	-17.9%	-26.0%	-24.3%	-10.8%	-14.9%	-4.9%	-10.5%	-9.1%	N/A
% change in price	-20.1%	-26.0%	-26.7%	-14.8%	-21.4%	-11.8%	-18.8%	-17.2%	-17.2%

**Note:** Price changes are based on the data underlying Table 2, comparing the average prices of the calendar year 1881 to those for the year running from July 1886 to June 1887, when our butterine series ends. Percentage change from margarine is calculated by multiplying the estimated elasticity by the change in the butterine price. Note that Danish butter prices in Manchester do not cointegrate with margarine prices (Table 3).

The change in the price is a function of both the effect from margarine, the supply of butter more generally, and the price of inputs, as well as macroeconomic conditions. In fact, Table 4 demonstrates that Danish prices actually fell considerably more than Cork 1<sup>st</sup>s over this period, albeit from higher levels with potentially higher margins and increasing revenue for producers. This is because not just prices, but also quantities produced change vastly over this short period, as Table 5 shows.

**Table 5: Annual compound average growth rates of spreads imported into Britain, 1881-87**

Ireland	-2.4%
Holland	-13.4%
Denmark	9.7%
Germany	4.5%
Belgium	-9.2%
France	-2.6%
Other Foreign	-4.0%
Margarine	21.7%
Total	6.3%
Butter only	-1.8%

**Source:** Authors' calculation from data underlying Figure 1.

Imports from the Netherlands and Belgium decreased the fastest (although they later partially recovered in the 1890s), while imports of margarine and Danish butter increased at high annual growth rates. The overall increase in supply of spreads of more than 6 per cent per year should have affected prices negatively in general, most of this attributable to margarine. However, the fast growth of supply of Danish butter, produced with increasing productivity and efficiency both regarding milk production and its transformation into butter (Henriksen et al 2011, Lampe and Sharp 2013), a consequence of adapting to the margarine challenge, contrasts with falling imports from almost all other destinations. The ability of Denmark to adapt might in part be due to the flexibility of the cooperative form of production (emulating advances already made on the traditional estates), making the quality improvements easier to implement for large numbers of peasant farmers.<sup>33</sup>

So while Danish butter saw similar falls to that of Irish over the years 1881-1887, only a small fraction of this was due to the effect of margarine,<sup>34</sup> compared to around fifty per cent for Irish

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<sup>33</sup> Thanks are due to an anonymous referee for pointing this out to us. See also Henriksen, Hviid and Sharp 2012.

<sup>34</sup> In accordance with this, leading agriculturalists and merchants in Denmark saw margarine and potential overproduction as the two main threats for Danish producers (Rützou 1887, p. 287, and the following discussion).

butter. It is difficult to establish a fully valid counterfactual scenario for the cost-benefit analysis of the Danish and Irish strategies, but a first approximation might be to assume similar increases in the supply of Danish butter, but not the quality. In this case, the price of Danish butter might have suffered from a similar elasticity with respect to the price of margarine as Cork 2<sup>nd</sup>s and 3<sup>rd</sup>s, and its price would then of course have fallen considerably more than that of its Irish counterpart (which did not see similar increases in supply). Since, as discussed above, in the 1860s and 1870s Danish peasant butter was comparable to the secondary qualities of Irish butter, we can conclude that by upgrading to a uniform quality Danish peasants managed to escape from the 'margarine trap'.

## V

The story above, of butter suffering due to the inability to differentiate it from margarine, seems to be a clear case of where legislation would be necessary in order for consumers to make informed decisions, and for producers to realize the proper price for their products. In fact, laws to this effect were enacted in all countries, largely due to pressure from butter producers, and margarine eventually became subject to a great deal of discriminatory legislation<sup>35</sup> (Van Stuyvenberg 1969), usually through a ban on adding yellow colouring, and through 'warning' signs in places where margarine was sold. This legislation appeared too late, however, to have an impact on the story told above, although some discussion of this seems relevant here, in as much as it ensured that the reputation established by premium producers of butter was maintained.

Denmark was the first to act, although margarine was relatively late coming to Denmark. Until 1884 it was imported (from Norway and Holland) and was known as Norwegian butter (a Frenchman had started a factory in Oslo). But in 1884 the first margarine was produced in Denmark. The threat to the reputation and price premium on Danish butter was obvious. In an attempt to avoid this, Denmark passed the world's first Margarine Law on 1 April 1885,

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<sup>35</sup> Not least in the United States (Dupré 1999, Miller 1989, Snodgrass 1930).

declaring that margarine should be clearly marked, and with a promise that, due to it taking the law to new areas, it would be reconsidered after three years.

This failed to allay fears, however, and a political debate of perhaps unprecedented proportions began, which ran through all levels of society (Higgins and Mordhorst 2008). Thus began the 'Butter War' or 'Margarine War' as it is sometimes known. In 1886 a commission was formed to investigate the margarine problem, formed of the highly respected T.R. Segelcke from the Royal Agricultural College in Copenhagen, two chemists, two estate owners, and a butter trader (but notably no one from the margarine industry). They reported on 21 September 1886 that margarine had indeed destroyed the Dutch butter industry, but that margarine was both healthy and cheap, so they did not recommend a ban but rather simply new controls (Stranskov et al 1998, pp. 66-7).

The situation remained volatile, however, eventually resulting in the passage of a much tougher margarine law on 1 April 1888 (Strandskov et al 1998, p. 81), which enforced the display of warning signs in stores selling margarine, forbade the mixture of margarine with more than 50 per cent butterfat<sup>36</sup>, and included a ban on the addition of yellow colouring to margarine<sup>37</sup>, which was necessary to make it appear like butter, and without which exports to the UK were impossible (Standskov et al 1998, p. 84). Finally, the Margarine Law of 1897 restricted the amount of butter fat to be blended with margarine from 50 to 15 per cent, and it was forbidden to add any preservatives other than salt (Drejer 1925-33, pp. 387-8). Interestingly, in fact,

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<sup>36</sup> As Otto Mønsted (1933), a large producer of margarine in Denmark, made clear, this provision was actually more damaging for butter producers.

<sup>37</sup> This was somewhat ironic, since Danish winter butter, produced by cows kept in barns, was naturally paler than its summer counterpart, which was produced using cows grazed on grass, and was therefore often also coloured (Stranskov et al 1998, p. 72). Note also that the Danish law was much less restrictive than those of some dairy states in the United States. Miller (1989, p. 108-110) and Dupre (1989, p. 355) mention state legislation in New Hampshire, West Virginia and Vermont from the 1880s and 1890s that required margarine to be coloured pink!

despite its importance for the Danish economy, the only laws for the dairy sector passed between 1880 and 1900 were those concerning margarine.<sup>38</sup>

In the UK (and thus also Ireland), the regulatory framework in force in the early 1880s was the Sale of Food and Drugs Act (1875), which, as French and Philips (2000) have highlighted, was mostly aimed at preventing fraud and adulteration by retailers, stating that ‘no person shall sell to the prejudice of the purchaser any article of food or any drug which is not of the nature, substance, and quality of the article demanded by the purchaser’. When margarine appeared prominently on the British market, butter producers requested similar protection to that in Denmark. On January 1<sup>st</sup>, 1888, the Margarine Act 1887 entered into force. As in Denmark, the law had been introduced to Parliament (House of Commons) by dairy interests, in this case six Irish MPs, of which one was a Cork butter merchant and the others also had been elected by dairy counties (French and Philips 2000., p. 41), while many of the experts informing the prior parliamentary inquiry, among them Thomas Pearson, the source of our butterine prices, thought the SFDA 1875 to be sufficient to prevent fraudulent margarine sales (French and Philips 2000, p. 41). Inspired by the Danish Margarine Law of 1885, the UK Margarine Act aimed at ‘the better prevention of the fraudulent sale of margarine’. It contained a number of provisions designed to prohibit the sale of margarine as butter. For example, every manufacturer of margarine was required to register with and to be inspected by the local authority, a unique feature in British manufacturing regulations of the period, and packaging was required to display clearly the word ‘Margarine’ (French and Philips 2000, pp. 41-42; Higgins and Mordhorst, 2008, p. 193). However, the Margarine Act apparently did little to halt

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<sup>38</sup> Somewhat ironically, however, Danes soon became one of the leading consumers of margarine, a point noted by Lenin, who considered it evidence of the cost to Danish peasants of capitalist agriculture: ‘Danish well-to-do peasants, but above all the Danish capitalists, make a good deal of money from the butter trade. And yet Denmark is the world’s biggest consumer of substitute butter, margarine! What is the explanation? It is very simple. The vast majority of the Danish population, like that of any other capitalist country, consists of workers and propertyless peasants. They cannot afford real butter. Even the middle peasants in Denmark, being in need of money, sell abroad the butter they produce on their farms and buy the cheap margarine for themselves.’ Lenin (1973) vol. 18, pp. 224-5.

margarine sales in Britain, leading to a new round of inquiries and legislative activity, ultimately including new labelling requirements in the SFDA 1899, the 1902 Sale of Butter Regulation and a new Butter and Margarine Act in 1907 (French and Philips 2000, pp. 45-61). French and Philips (2000, p. 64) summarize the economic impact of these Acts and Regulations stating that they 'failed to check the expansion of margarine sales' (p. 64). So, while Danish margarine regulation and the later activities of the Danish dairy representative in Britain, Harald Faber, seem to have done much to establish confidence in Danish butter (Higgins and Mordhorst 2008; French and Philips 2000, p. 49), the problems margarine caused for Irish producers were not solved by British regulations.

In the Netherlands legislation similar to the Danish came far too late. It was only in 1889 that a law concerning the butter trade (the *Boterwet*) was introduced to address the problems of tampering and declining quality (Bieleman 1996, p. 19, Bieleman 2010, pp. 192-199).

## VI

We analyse the impact of a new product, which despite different ingredients and production technologies constituted a close substitute to existing low quality varieties, on the structure of production and demand in an established market. We have shown, both from historical sources and with formal econometric analysis, that the introduction of the new substitute, margarine, had an impact on all established producers in the market for spreads, by increasing total supply. After all, the invention of margarine by Mège-Mouriès responded to a prize offered by Napoleon III due to rising relative prices of butter, indicating a shortfall of supply in relation to demand in the middle decades of the nineteenth century (Snodgrass 1930, pp. 122-123; Hoffmann 1969, pp. 9-13). The evolution of relative prices of animal products versus grains in Britain (see Henriksen, Lampe and Sharp 2012, Figure 3, see also Donnelly 1971, p. 131-132) and the quick success of butterine on the British market indicate that this phenomenon was not unique to France, and hence the invention of margarine was not really an exogenous shock to the butter industry, but endogenously determined.

However, the impact of the new substitute was different for different product varieties, and hence low-quality butter producers suffered much more from the price reduction resulting from the outward shift of the supply curve than those of high-quality varieties. In our case, Danish producers of the best variety, estate butter, who already over the preceding decades had been in a process of continuous quality improvements, were able to use the new challenge to their advantage. Furthermore, the knowledge of producing and marketing high-quality butter trickled down quickly to the average producer of former peasant butter. An upgrade of average qualities and the disappearance of low quality varieties from the product portfolio then became possible. We thus argue that the appearance of margarine ‘greased the wheels of transformation’ in the sense that it provided critical incentives for the adoption of technologies, institutions and marketing practices, such as cream-separators, winter dairying and the co-operative form of production.<sup>39</sup> This process happened in the other main supplier of butter to the British market, Ireland, but producers there did not adapt quickly enough to the joint challenge of Danish butter and cheap margarine. The reason for this is likely to be found in domestic institutions regarding the organization of the production process. A similar explanation might be given as to why margarine could emerge in the Netherlands and damage the reputation of Friesland butter – the very reason for the ‘Butter War’ in Denmark.

Future research might attempt to compare our methodological approach and results to similar cases in history, although we are not aware of similar studies in history or in economics, apart from the industrial organization literature referred to above.<sup>40</sup> Having deeper insights into the

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<sup>39</sup> The recent study by Higgins and Mordhorst (2008) of the Lurbrand for ‘Danish Produce’ established on the British market in the last years of the nineteenth and the first decades of the twentieth century shows that Danish ‘quality upgrading’ was not the last stage of the process of maintaining and increasing the competitiveness of Danish butter. Their account, however, is different from ours, since they refer to value creating beyond increasing quality, as reflected in the creation and defense of ‘brand value’ to British consumers of Danish co-operative butter (Higgins and Mordhorst 2008, pp. 196-198). The developments analyzed in the present article might therefore be at a critical point in a virtuous circle.

<sup>40</sup> An interesting example might be that of olive oil, where Ramon-Muñoz (2011a, 2011b) has named the collapse of industrial markets (olive oil as lubricants) due to the ‘invasion of oleaginous products’ – palm oil, mineral oil and

effects of new products in existing markets might for example allow for insights into the process of Schumpeterian 'creative destruction' – which, it seems, need not be so destructive after all.

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the like – since the early 1880s as a major incentive to improve and homogenize quality through the use of better techniques. The storage time of olives before pressing was minimized, as was the risk of producing oil with a rancid taste.

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### Appendix: Misspecification tests for the regressions in Table 3

The following reports the results of the misspecification tests reported by PcGive 13. They are reported both at the level of the individual equations and the system as a whole. The Portmanteau statistic provides a test for (no) residual autocorrelation. The other statistics are tests for (no) ARCH, normality and (no) heteroskedasticity. See Doornik and Hendry 2009, pp. 235-7 for more on this. P-values are in square parentheses. Most importantly, autocorrelation is never a major concern. (8) has strong indications of both non-normality and heteroskedasticity, so the results for these prices should be viewed with this in mind.

(1)

Vector Portmanteau(12):  $\text{Chi}^2(40) = 55.414 [0.0533]$

Single-equation diagnostics using reduced-form residuals:

$p_t^\beta$ : Portmanteau(12):  $\text{Chi}^2(10) = 12.667 [0.2429]$

$p_t^M$ : Portmanteau(12):  $\text{Chi}^2(10) = 6.6043 [0.7622]$

Single-equation diagnostics using reduced-form residuals:

$p_t^\beta$ : ARCH 1-5 test:  $F(5,66) = 0.44708 [0.8139]$

$p_t^\beta$ : Normality test:  $\text{Chi}^2(2) = 0.020293 [0.9899]$

$p_t^\beta$ : Hetero test:  $F(21,54) = 2.2086 [0.0101]^*$

$p_t^M$ : ARCH 1-5 test:  $F(5,66) = 0.28256 [0.9211]$

$p_t^M$ : Normality test:  $\text{Chi}^2(2) = 9.1804 [0.0102]^*$

$p_t^M$ : Hetero test:  $F(21,54) = 1.6258 [0.0774]$

Vector Normality test:  $\text{Chi}^2(4) = 12.018 [0.0172]^*$

Vector Hetero test:  $F(63,156) = 1.7222 [0.0036]**$

(2)

Vector Portmanteau(12):  $\text{Chi}^2(40) = 55.158 [0.0558]$

Single-equation diagnostics using reduced-form residuals:

$p_t^\beta$ : Portmanteau(12):  $\text{Chi}^2(10) = 19.219 [0.0376]^*$

$p_t^M$ : Portmanteau(12):  $\text{Chi}^2(10) = 6.1505 [0.8025]$

Single-equation diagnostics using reduced-form residuals:

$p_t^\beta$ : ARCH 1-5 test:  $F(5,66) = 2.2523 [0.0593]$

$p_t^\beta$ : Normality test:  $\text{Chi}^2(2) = 0.13700 [0.9338]$

$p_t^\beta$ : Hetero test:  $F(21,54) = 1.6695 [0.0668]$

$p_t^M$ : ARCH 1-5 test:  $F(5,66) = 0.32471 [0.8964]$

$p_t^M$ : Normality test:  $\text{Chi}^2(2) = 9.6294 [0.0081]**$

$p_t^M$ : Hetero test:  $F(21,54) = 1.2831 [0.2279]$

Vector Normality test:  $\text{Chi}^2(4) = 10.811 [0.0288]^*$

Vector Hetero test:  $F(63,156) = 1.2347 [0.1491]$

(3)

Vector Portmanteau(12):  $\text{Chi}^2(40) = 55.435 [0.0531]$

Single-equation diagnostics using reduced-form residuals:

$p_t^\beta$ : Portmanteau(12):  $\text{Chi}^2(10) = 15.512 [0.1145]$

$p_t^M$ : Portmanteau(12):  $\text{Chi}^2(10) = 5.5677 [0.8502]$

Single-equation diagnostics using reduced-form residuals:

$p_t^\beta$ : ARCH 1-5 test:  $F(5,66) = 1.0278 [0.4087]$

$p_t^\beta$ : Normality test:  $\text{Chi}^2(2) = 0.12446 [0.9397]$

$p_t^\beta$ : Hetero test:  $F(21,54) = 1.4022 [0.1592]$

$p_t^M$ : ARCH 1-5 test:  $F(5,66) = 0.34122 [0.8861]$   
 $p_t^M$ : Normality test:  $\text{Chi}^2(2) = 9.4100 [0.0090]**$   
 $p_t^M$ : Hetero test:  $F(21,54) = 1.7967 [0.0433]*$   
Vector Normality test:  $\text{Chi}^2(4) = 12.023 [0.0172]*$   
Vector Hetero test:  $F(63,156) = 1.4755 [0.0278]*$

(4)

Vector Portmanteau(12):  $\text{Chi}^2(40) = 58.296 [0.0308]*$

Single-equation diagnostics using reduced-form residuals:

$p_t^B$ : Portmanteau(12):  $\text{Chi}^2(10) = 17.236 [0.0693]$   
 $p_t^M$ : Portmanteau(12):  $\text{Chi}^2(10) = 8.5805 [0.5723]$

Single-equation diagnostics using reduced-form residuals:

$p_t^B$ : ARCH 1-5 test:  $F(5,66) = 0.40340 [0.8448]$   
 $p_t^B$ : Normality test:  $\text{Chi}^2(2) = 0.83741 [0.6579]$   
 $p_t^B$ : Hetero test:  $F(21,54) = 1.5562 [0.0974]$   
 $p_t^M$ : ARCH 1-5 test:  $F(5,66) = 0.29499 [0.9140]$   
 $p_t^M$ : Normality test:  $\text{Chi}^2(2) = 8.3443 [0.0154]*$   
 $p_t^M$ : Hetero test:  $F(21,54) = 1.1653 [0.3171]$

Vector Normality test:  $\text{Chi}^2(4) = 8.9073 [0.0635]$   
Vector Hetero test:  $F(63,156) = 1.1810 [0.2047]$

(5)

Vector Portmanteau(12):  $\text{Chi}^2(40) = 56.783 [0.0413]*$

Single-equation diagnostics using reduced-form residuals:

$p_t^B$ : Portmanteau(12):  $\text{Chi}^2(10) = 11.843 [0.2957]$   
 $p_t^M$ : Portmanteau(12):  $\text{Chi}^2(10) = 9.5210 [0.4835]$

Single-equation diagnostics using reduced-form residuals:

$p_t^B$ : ARCH 1-5 test:  $F(5,66) = 2.6612 [0.0298]*$   
 $p_t^B$ : Normality test:  $\text{Chi}^2(2) = 3.0707 [0.2154]$   
 $p_t^B$ : Hetero test:  $F(21,54) = 2.1069 [0.0146]*$   
 $p_t^M$ : ARCH 1-5 test:  $F(5,66) = 0.25776 [0.9344]$   
 $p_t^M$ : Normality test:  $\text{Chi}^2(2) = 10.496 [0.0053]**$   
 $p_t^M$ : Hetero test:  $F(21,54) = 1.1740 [0.3098]$

Vector Normality test:  $\text{Chi}^2(4) = 11.637 [0.0203]*$   
Vector Hetero test:  $F(63,156) = 1.3413 [0.0743]$

(6)

Vector Portmanteau(12):  $\text{Chi}^2(40) = 39.218 [0.5053]$

Single-equation diagnostics using reduced-form residuals:

$p_t^B$ : Portmanteau(12):  $\text{Chi}^2(10) = 11.543 [0.3168]$   
 $p_t^M$ : Portmanteau(12):  $\text{Chi}^2(10) = 6.9739 [0.7279]$

Single-equation diagnostics using reduced-form residuals:

$p_t^B$ : ARCH 1-5 test:  $F(5,66) = 0.38224 [0.8592]$   
 $p_t^B$ : Normality test:  $\text{Chi}^2(2) = 0.63411 [0.7283]$   
 $p_t^B$ : Hetero test:  $F(21,54) = 1.5969 [0.0852]$   
 $p_t^M$ : ARCH 1-5 test:  $F(5,66) = 0.55539 [0.7337]$   
 $p_t^M$ : Normality test:  $\text{Chi}^2(2) = 5.4521 [0.0655]$   
 $p_t^M$ : Hetero test:  $F(21,54) = 1.3397 [0.1927]$

Vector Normality test:  $\text{Chi}^2(4) = 6.1393 [0.1890]$   
Vector Hetero test:  $F(63,156) = 1.3333 [0.0785]$

(7)

Vector Portmanteau(12):  $\text{Chi}^2(40) = 30.501 [0.8608]$

Single-equation diagnostics using reduced-form residuals:

$p_t^B$ : Portmanteau(12):  $\text{Chi}^2(10) = 8.4176 [0.5881]$   
 $p_t^M$ : Portmanteau(12):  $\text{Chi}^2(10) = 8.5852 [0.5719]$

Single-equation diagnostics using reduced-form residuals:

$p_t^B$ : ARCH 1-5 test:  $F(5,66) = 2.6385 [0.0310]^*$   
 $p_t^B$ : Normality test:  $\text{Chi}^2(2) = 0.058375 [0.9712]$   
 $p_t^B$ : Hetero test:  $F(21,54) = 1.4223 [0.1496]$   
 $p_t^M$ : ARCH 1-5 test:  $F(5,66) = 1.0342 [0.4050]$   
 $p_t^M$ : Normality test:  $\text{Chi}^2(2) = 3.0409 [0.2186]$   
 $p_t^M$ : Hetero test:  $F(21,54) = 2.0116 [0.0204]^*$

Vector Normality test:  $\text{Chi}^2(4) = 3.6121 [0.4610]$   
Vector Hetero test:  $F(63,156) = 1.4360 [0.0375]^*$

(8)

Vector Portmanteau(12):  $\text{Chi}^2(40) = 34.080 [0.7331]$

Single-equation diagnostics using reduced-form residuals:

$p_t^B$ : Portmanteau(12):  $\text{Chi}^2(10) = 13.573 [0.1934]$   
 $p_t^M$ : Portmanteau(12):  $\text{Chi}^2(10) = 9.0684 [0.5256]$

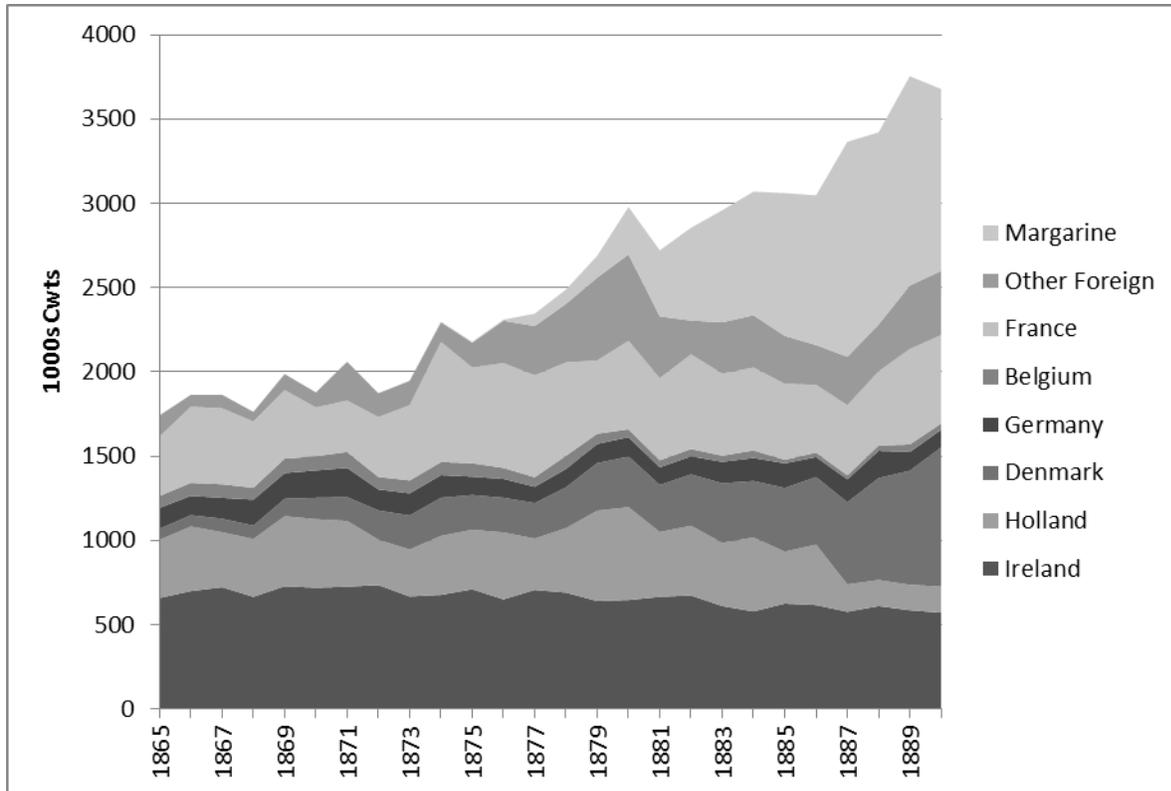
Single-equation diagnostics using reduced-form residuals:

$p_t^B$ : ARCH 1-5 test:  $F(5,66) = 0.76053 [0.5815]$   
 $p_t^B$ : Normality test:  $\text{Chi}^2(2) = 0.63537 [0.7278]$   
 $p_t^B$ : Hetero test:  $F(21,54) = 1.0932 [0.3827]$   
 $p_t^M$ : ARCH 1-5 test:  $F(5,66) = 0.12491 [0.9863]$   
 $p_t^M$ : Normality test:  $\text{Chi}^2(2) = 11.505 [0.0032]**$   
 $p_t^M$ : Hetero test:  $F(21,54) = 2.3863 [0.0054]**$

Vector Normality test:  $\text{Chi}^2(4) = 14.288 [0.0064]**$   
Vector Hetero test:  $F(63,156) = 1.6497 [0.0067]**$

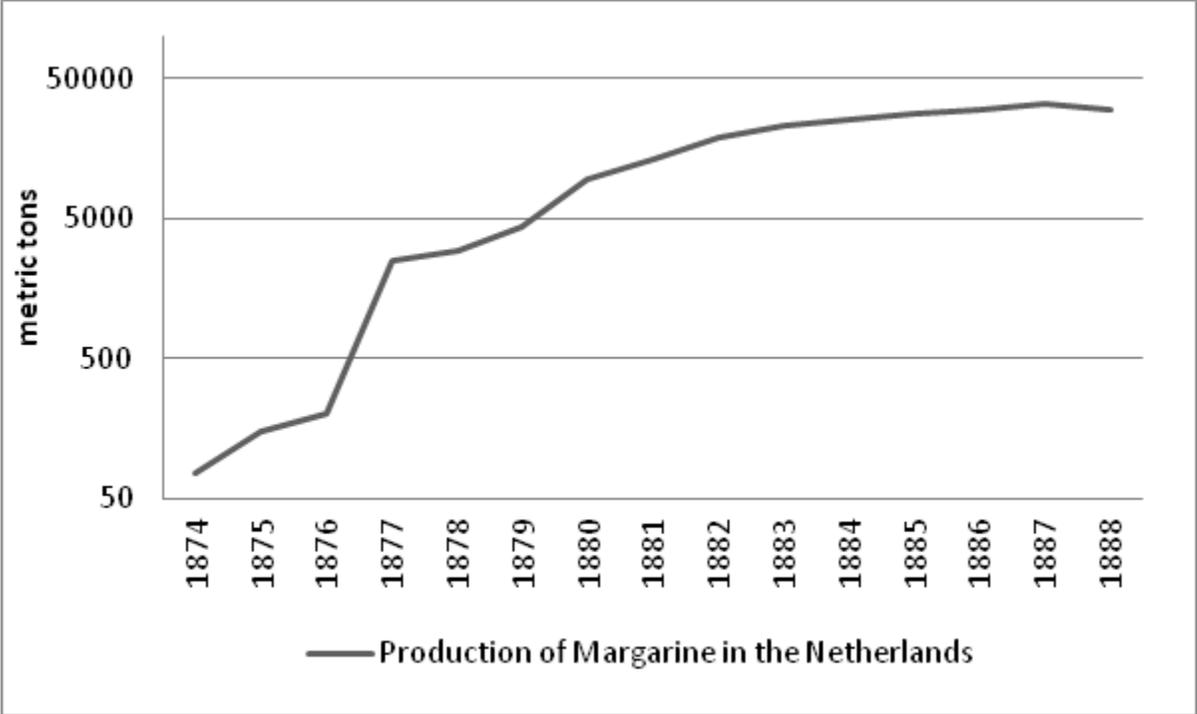
## Figures

**Figure 1: Butter imports to Great Britain, 1860 and 1890**



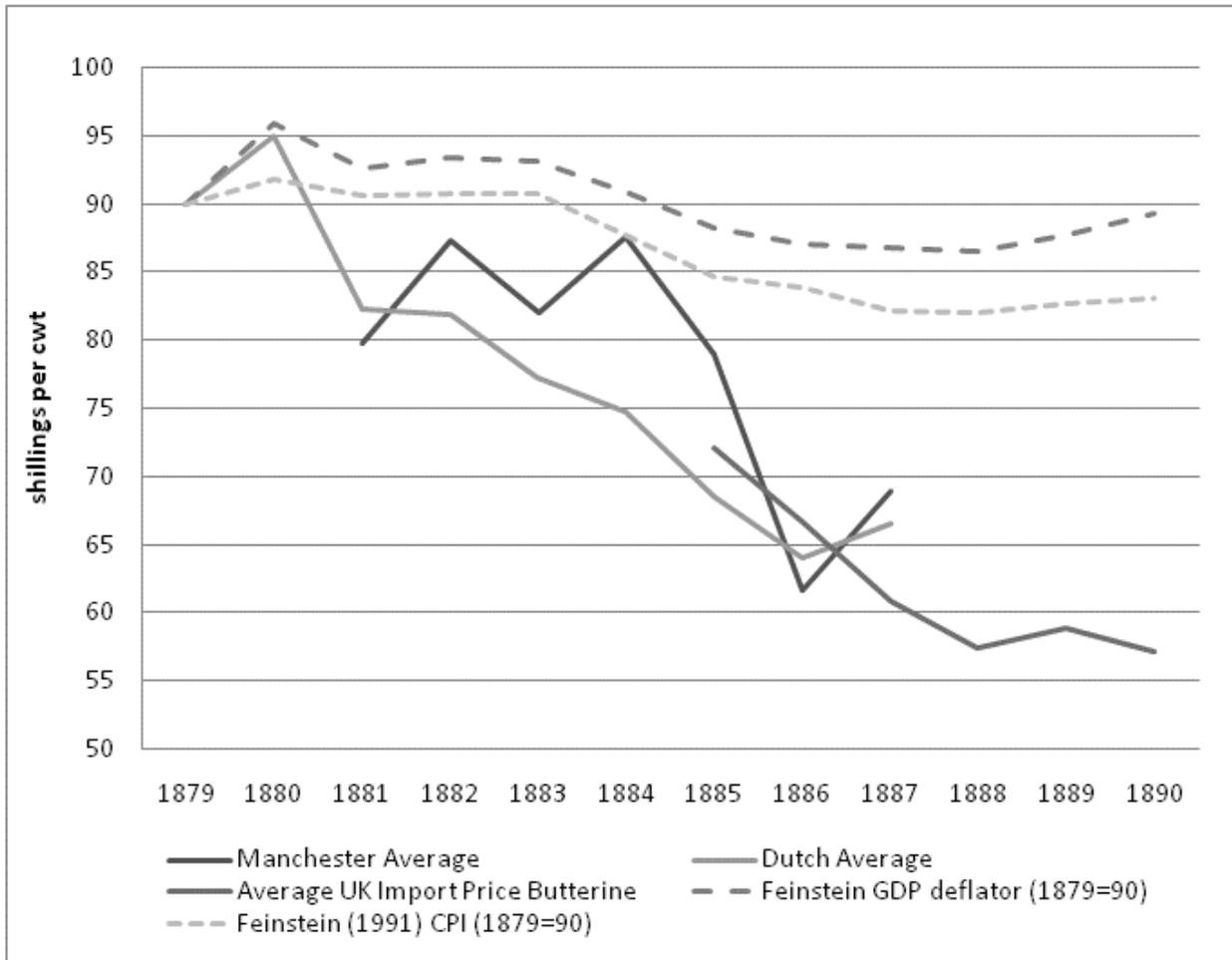
**Source:** Butter imports: *Annual Statement 1866-1891*; Ireland from Solar (1990). Margarine imports before 1885: BPP (1887, p. 142) for 1884 then interpolated from Dutch margarine production index based on 'Margarineboter-Industrie' in: *Bijdragen van het Statistisch Instituut 5* (1889), pp. 135-137. Margarine imports before 1885 have been deducted from butter imports totals and different countries according to their average participation in imports of 'butterine' in 1885-1889 according to British trade statistics (92.1% Netherlands, 2.5% France, 2.0% Belgium, 1.1% Germany, 0.03% Denmark, Other Foreign countries 2.2%, mainly Norway (1.5%)).

Figure 2: Production of Margarine in the Netherlands, 1875-1888 (log scale)



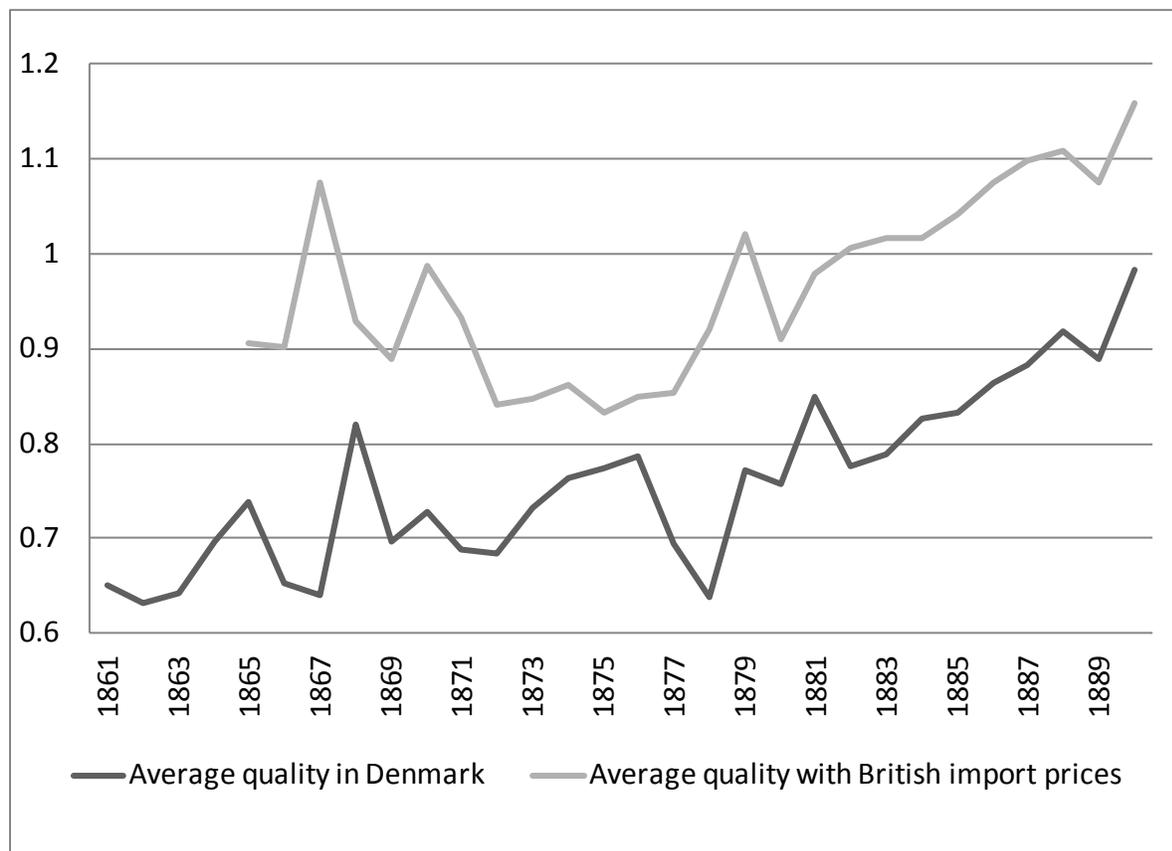
Source: 'Margarineboter-Industrie' in: Bijdragen van het Statistisch Instituut 5 (1889), pp. 135-137.

**Figure 3: Prices of Margarine/Butterine, 1879-1890**



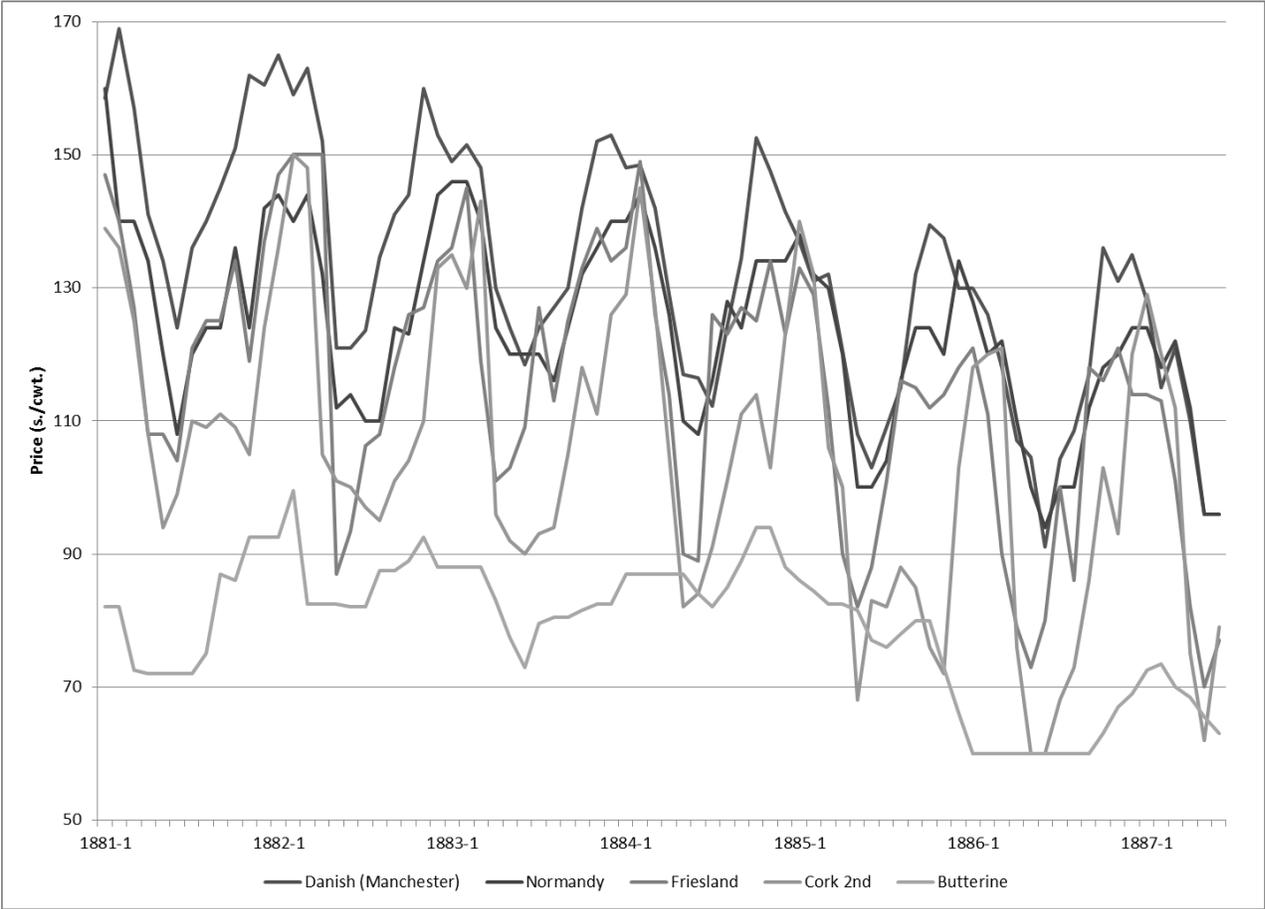
**Sources:** 'Manchester Average' calculated from monthly data (January 1881-June 1887) handed in by Thomas Pearson of the Co-operative Wholesale Society of Manchester to the Select Committee on the Butter Substitutes Bill, BPP 1887 (208), pp. 144-146; 'Dutch Average' as mean of 'high' and 'low' annual prices (1879-1887) reported in 'Margarineboter-Industrie' (as in Figure 2); 'Average UK Import Price Butterine' (1885-1890) from *Annual Statement* [1885-1890]. Feinstein UK GDP deflator obtained by dividing the Current by the Constant 1900 price GDP estimates in Mitchell (2003, p. 907), the Feinstein (1991) consumer price index is from Feinstein (1991, p. 170).

**Figure 4: Average quality of Danish butter in the United Kingdom (imports from Denmark) and in Denmark (production), 1861-1890.**



**Sources:** ‘Average quality in Denmark’ is the ratio of the ‘Kapitaltakster’ valuation (taken from Christensen 1985) to the top quality price, which until 1880 is ‘Herregadssmør Prima’ (from Drejer 1925-33, p. 326) and then the average of the first weekly quotation for June, August, October and December of prima/highest export butter (Finest/Prima Manor) in the Copenhagen Brokers' Current (data kindly provided by Ingrid Henriksen, see Henriksen and O'Rourke 2005). ‘Average quality with British import prices’ is the ratio of the average unit value of imports of Danish butter into the United Kingdom (sources as for Figure 1) to the same top quality price series in Copenhagen. Values for this series can exceed ‘1’ since between the Copenhagen and the port of entry in the United Kingdom transport and other trade costs occur. Unfortunately price quotes for Danish butter in London are incomplete even for the late 1870s and lacking for earlier periods.

**Figure 5: Monthly prices of butter and butterine, January 1881 – June 1887**



**Sources:** See the text.

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