*American Economic Journal: Macroeconomics 2024, 16(1): 102–146*
*https://doi.org/10.1257/mac.20210074*

# Immigrant Communities and Knowledge Spillovers: Danish Americans and the Development of the Dairy Industry in the United States†

*By* Nina Boberg-Fazlić and Paul Sharp*

*Despite the growing literature on the impact of immigration, little is known about the role existing migrant settlements can play for knowledge transmission and the location of industry. We present a case that can illustrate this important mechanism and hypothesize that nineteenth-century Danish American communities helped spread knowledge on modern dairying to rural America. From around 1880 Denmark developed rapidly, and by 1890 it was a world-leading dairy producer. Using a difference-in-differences strategy and data taken from the US census and Danish emigration archives, we find that counties with more Danes in 1880 subsequently both specialized in dairying and used more modern practices.* (*JEL* J15, J61, L66, N31, N51, O33, Q12)

In what way can established immigrant communities serve to promote economic development? A number of recent works have demonstrated that high-skilled immigrants can promote knowledge and technology transfer (Hornung 2014), improve human capital (Kerr and Lincoln 2010; Hunt and Gauthier-Loiselle 2010; Moser, Voena, and Waldinger 2014; Rocha, Ferraz, and Soares 2017),[1] and impact growth more generally through patenting or skill complementarities (Akcigit, Grigsby, and Nicholas 2017a, b; Docquier et al. 2020).[2] Rodríguez-Pose and von Berlepsch (2015) demonstrate a positive effect of historical migration

* Boberg-Fazlić: Department of Business and Economics, TU Dortmund University and CEPR (email: nina.bobergfazlic@tu-dortmund.de). Sharp: Department of Economics, University of Southern Denmark, CAGE, and CEPR (email: pauls@sam.sdu.dk). Ayşegül Şahin was coeditor for this article. We are grateful to Philipp Ager, Vellore Arthi, Casper Worm Hansen, Peter Sandholt Jensen, and Thomas N. Maloney for very helpful suggestions. We thank seminar and conference participants at the University of Southern Denmark, University of Copenhagen, Helsinki, Munich, Duisburg-Essen, NYU Shanghai, Russian Presidential Academy of National Economy and Public Administration, the Social Science History Association conference 2018, the Third Congress for Economic and Social History at the University of Regensburg, the Tenth Annual Workshop on Growth, History and Development in Odense, CLADHE VI at the University of Santiago de Chile, the European Historical Economics Society 2019 at Paris School of Economics, the Forty-Fourth Simposio de la Asociación Española de Economía-Spanish Economic Association (SAEe) at the University of Alicante, Spain, and the ASSA 2020 in San Diego for comments and suggestions. This version of the paper owes much to excellent feedback from Senior Editor Madeline Zavodny and two reviewers from the Center for Growth and Opportunity, Utah State University. Nina Boberg-Fazlić gratefully acknowledges funding from the Independent Research Fund Denmark (grant no. 6109-00287B).

† Go to https://doi.org/10.1257/mac.20210074 to visit the article page for additional materials and author disclosure statement(s) or to comment in the online discussion forum.

[1] Although they might also displace domestic knowledge producers (Borjas and Doran 2012).

[2] Somewhat related to this, Hunt and Gauthier-Loiselle (2010) show that immigration can have a positive effect on economic growth by fostering innovation.

on current levels of development across US counties.[3] None of these studies have, however, touched on the impact an existing migrant community can have on the adoption of technology in the wake of significant developments in their country of origin. The present work presents just such an example, where the small Danish settlements established in the United States before 1880 came to play an important role in spreading information on subsequent radical changes that were taking place in Danish agriculture, dairying in particular. Our hypothesis is that Danish communities in the United States facilitated the spread of information on the revolutionary changes in dairying that were taking place at home.

To investigate this, we exploit the exogeneity of the pre-1880 Danish settlements, which were presumably established with no knowledge of advances in Denmark that were only to come about subsequently. Thus, in a difference-in-differences framework, we find that the areas "treated" with more Danes are associated with a greater specialization in dairying before the First World War. Moreover, although data are lacking that would allow us to calculate productivity measures, we are able to demonstrate an association with the use of more advanced technologies. In fact, the association between these areas (largely in the Midwest) and dairying can even be detected after the Second World War.[4] We also attempt to pin down the mechanism. We compare the importance of the immigration of "relevant" Danes (i.e., those with a background in dairying) to the spread of information about modern dairying through contact with Denmark. We do not, of course, have the sort of information on direct communication between individuals that Conley and Udry (2010) used to investigate knowledge flows between pineapple growers in Ghana. What we do, however, is exploit data from the Danish emigration registers on return migrants (i.e., Danish Americans who came back to Denmark for some time) and combine this with evidence from contemporary Danish language newspapers published in the United States. Consistent with our prior supposition, we find that the information channel is by far the most important. Thus, our work is closely related to and yet contrasts with that of Hornung (2014), who demonstrates how high-skilled immigration of Huguenots to Prussia led to a diffusion of technology and higher productivity in the textile sector of that country.[5] In our case, this was not primarily a story of expert migrants bringing benefits to their destination country, but rather an example of how existing migrant communities can play an important role in the spread of knowledge and technology from abroad, although they certainly later also attracted skilled labor from home. The present work also relates to work by Kantor and Whalley (2019), who measure

[3] They also investigate the role of the origins of the migrants, specifically in terms of institutional quality, but find this to be of minor importance for development.

[4] Rauch and Trindade (2002) and Ammon and Baiardi (2023) provide another example of unanticipated economic gains from migration decades after arrival. These studies demonstrate that countries with ethnic Chinese communities see an important impact on trade with each other. Karreman, Burger, and van Oort (2017) demonstrate a positive impact on investment by Chinese firms. This is especially interesting in the context of the present work given the importance of trade with China today and the fact that Chinese were the first ethnic group to be specifically discriminated against in the United States under the Chinese Exclusion Act of 1882.

[5] See also Fourie and von Fintel (2014) on the effects of Huguenot migration on wine production in South Africa, and Frost (2002), who finds a beneficial effect of Chinese immigrants on Australian agriculture between 1850 and 1920, including farmers of European descent.

local ideas by the proximity to US federal agricultural experiment stations, finding that this explains regional agricultural productivity. They make the important point that it can often be difficult to measure knowledge flows, since it is typically not geographically constrained, although agriculture is an exception. We provide further evidence for this, but with the additional angle that this can be facilitated by migrant settlements as well as federal agencies.

Danish agriculture developed rapidly from the 1880s with the emergence of a modern dairy industry, which many consider to have been a decisive factor in that country's catch-up with the richest countries of the time (for a brief account, see Henriksen 1993). Previous work (Lampe and Sharp 2019; Boberg-Fazlic et al. 2023) has demonstrated that this rested on developments since the eighteenth century, when an agricultural elite from the Danish duchies of Schleswig and Holstein introduced new methods, including centralized butter making facilities. It took, however, the invention of a new technology, the automatic cream separator (a steam-powered centrifuge), before peasant production could be centralized under a new institution, the cooperative creamery.[6] The first of these was founded in 1882, followed by hundreds of others around the whole country within a decade, although adoption rates differed according to differences in the prior treatment by the aforementioned elites. Massive increases in productivity followed, production boomed, and Denmark captured a large share of the important UK market for butter and other agricultural products. This success is usually set within the context of the American "grain invasion" from the 1870s (O'Rourke 1997), when cheap exports of largely US grain flooded Europe, promoting a backlash of protectionism. Denmark, like the United Kingdom, chose to remain open, however, and successfully exploited its comparative advantages (created or discovered by the elites in the previous century), using the cheap grain as fodder for increased animal production.

In the context of migration, Denmark is also an exceptionally interesting case to study, but not due to its large out-migration. Denmark is and was of course a small country, with little obvious opportunity for its emigrants to make a large impact on the United States, with a population of less than two million around 1880. Moreover, in contrast to its Scandinavian neighbors, Norway and Sweden, which witnessed massive out-migration in the nineteenth century, Danish emigration was relatively modest. Between 1840 and 1914, only 309,000 Danes emigrated, approximately 16 percent of the population, compared to 24 percent in Sweden and almost 39 percent in Norway (Hvidt 1971). Part of this was due to Denmark's aforementioned agricultural leadership. We argue that this highly productive and innovative agricultural sector also meant that despite being few in number, emigrants from Denmark transferred knowledge that potentially boosted economic growth in the host country, and established a perhaps surprisingly persistent geographical pattern for the American dairy industry. Thus, as Denmark had benefited from openness to ideas from Schleswig and Holstein in the 1700s, the United States then in turn benefited from the 1880s once modern dairying had

[6] The reason why Denmark so successfully adopted cooperatives is explored in a number of works, most notably perhaps by O'Rourke (2006, 2007), who contrasts Denmark with Ireland.

spread to the Danish peasantry, who transmitted their knowledge of new production processes and technologies through preexisting emigrant communities and through new migration.

We thus examine the effect of relatively modest numbers of Danish immigrants on economic development and industrial location in the United States, and for the dairy industry in particular. Theory suggests that technological progress is one of the most important drivers of economic growth (Galor and Weil 2000; Howitt 2000). If immigrants shift the technological frontier by bringing in new knowledge and ideas, immigration can boost economic growth and thereby be beneficial for regional development. Empirically, however, technological progress is often just the residual as it is difficult to measure. Moreover, the link between immigration and technological progress and ultimately economic growth is not well established, mainly due to a lack of data. Thus, although the research on the economic consequences of migration has advanced greatly in recent years (see, for example, Longhi, Nijkamp, and Poot 2005 and Kerr and Kerr 2011 for surveys), it has as yet failed to reach a consensus. The empirical evidence on the short-run link is mixed. Peri (2012) finds short-run productivity gains upon immigration, but other authors find negative effects (e.g., Ortega and Peri 2009) or no effect (e.g., Quispe-Agnoli and Zavodny 2002). As for the long run, Hatton (2010) summarizes much of the cliometric literature on international migration for the period 1850–1940 and mostly for Europeans moving to the New World. His survey divides the literature into a number of themes, including the forces driving migration, over time and across space; the assimilation of migrants and their effects on wages and income distribution in source and destination countries; and the evolution of immigration policy.[7] Abramitzky, Boustan, and Eriksson (2012) find only a modest return to migration for Norwegian emigrants and show that emigrants were, at least in urban areas, negatively selected from the population. A number of papers have demonstrated the links between coethnic networks and international trade[8] (which might be an obvious channel for technology transfer). Buchardi and Hassan (2013) find that West German regions where more households had maintained social ties with East Germany in 1989 experienced higher growth after the fall of the Berlin Wall due to the ability of entrepreneurs to better exploit opportunities in the east. Likewise, Buchardi, Chaney, and Hassan (2019) use 130 years of data on historical migrations to the United States to demonstrate a causal effect of the ancestry composition of US counties on foreign direct investment sent and received by local firms. More recently, Sequeira, Nunn, and Qian (2020) have found that locations in the United States with more historical immigration have today higher incomes, less poverty, less unemployment, higher rates of urbanization, and greater educational attainment, which they attribute to the persistence of considerable short-run benefits, including greater industrialization, increased agricultural productivity, and more innovation. Finally, a number of studies demonstrate a relationship between immigration, trade flows, and

[7] See also the survey for the United States by Abramitzky and Boustan (2017).

[8] See, for example, Greif (1989, 1993) and Gould (1994), as well as Rauch and Trindade (2002) and Ammon and Baiardi (2018).

the diffusion of innovations (see, for example, Bahar and Rapoport 2018; Bahar, Choudhury, and Rapoport 2018; Lissoni 2018). None of these papers specifically consider the impact existing migrant settlements can have on later knowledge transfer, however.

Of particular relevance to the present study is the work of Ottinger (2020), who explains how specialization in specific manufacturing industries reflected earlier migrant flows. These "accidents" (Arthur 1990) led to some persistence in industrial location across US counties reflecting past immigration. Ottinger explains how comparative advantage potentially "embodied" in immigrants from 13 European countries by 1850, as measured by their exports to the United States in 1909, predicts employment in 49 manufacturing industries. The present work distinguishes itself from his in at least two dimensions. First, we present a detailed case study of a group of migrants who never constituted a significant share of the American population. They were usually not highly skilled, but, we argue, they nevertheless provided a vehicle for transfer of knowledge. Second, and related to the first, we argue against the primary relevance of the migrants themselves working in the industry, and more in favor of their facilitation of knowledge transfer, a mechanism we subsequently attempt to pin down.

Otherwise, the present work is also closely connected to recent studies that show the long-run impact of the adoption of agriculture (Olsson and Hibbs 2005; Putterman 2008; Comin, Easterly, and Gong 2010; Cook 2014b) and major productivity improving implements like the heavy plough (Andersen, Jensen, and Skovsgaard 2016), as well as complementing the emerging literature on the effects of new crops on productivity, population and economic growth, and political stability (e.g., Nunn and Qian 2011; Bustos, Caprettini, and Ponticelli 2016; Cook 2014b, a; Dall, Jensen, and Naz 2014; Chen and Kung 2016; Jia 2014).

Our findings also speak to the debate about immigration controls, including so-called "point systems," whereby potential immigrants are assessed based on a number of criteria, including, for example, age, educational attainment, language, etc. Similar concerns were of course also present in the past. Ironically, in a report by Cance (1925) that came out in the wake of the Emergency Quota Act of 1921, which established quotas by nationality, the author (unwittingly) underlines the point about how it is difficult to know which migrants are "desirable." He falls into the trap of assuming that previous generations of migrants were the "right" migrants, specifically mentioning the large number of Scandinavians in agriculture, and concluding that "some of the very best of our farmers are immigrants of the first and second generation" (113). He concludes, however, with a warning against importing cheap labor to the countryside, since he believed this would hurt rural living standards and delay the process of assimilation, without seemingly realizing that discriminating against poor rural migrants would have meant that the Scandinavians he praises would not have arrived in the first place.

In the remainder of this paper, we first provide a literature review, which also provides more detail on the historical background to our story. In Section II, we discuss the data used in the analysis and the empirical strategy employed. In Section III, we present our results, along with a number of robustness checks and some evidence on the underlying mechanism. Section IV provides the conclusion as well as a discussion of possible policy implications.

## I. Historical Background

### A. *The History of Danish Emigration to the United States*

There are a number of studies of Danish migration to the United States. The most detailed is that by Hvidt (1971),[9] who, as is common in the literature, divides the reasons for migrating into "push" and "pull" factors.[10] He bases his account on Danish police records, and this section draws heavily on his work. Relatively few Danes migrated to the United States before 1866: only 14,000 between 1820 and 1866, of whom many were Mormons. From this point the numbers increased somewhat, and emigrants were relatively evenly spread according to population from different parts of the country (Hvidt 1971, 100). Many left northern Schleswig after Denmark lost the Duchies of Schleswig and Holstein to Prussia in 1864, and others migrated from 1865 on, as the Danish government became less liberal with respect to religion (Furer 1972, 45).

Emigration from Denmark increased from the late 1860s, with around 158,000 leaving for the United States between 1868 and 1900. Hvidt (1971) demonstrates that two-thirds of these emigrants knew exactly where they wanted to go (state, county, and settlement), and just one-third had a ticket to New York, from where they either stayed or moved on. Of the roughly 88,800 emigrants who knew where they would go, Hvidt (1971) argues that they were probably pulled to the United States by personal contacts (through a job opening or letters from earlier emigrants) or by railroad companies selling land through agents in Denmark. Railroad companies would buy large areas of land in the United States and then finance construction by selling off plots along the planned tracks, thereby also ensuring future customers. Danish statistics cannot really tell us about the number of emigrants returning, but Hvidt (1971) believes there were relatively few, perhaps around 10 percent. The greatest extent of Danish immigration was reached in 1882, when 11,000 Danes arrived in a single year, many of whom were small farmers and laborers who sought land and jobs in the interior areas of America (Furer 1972, 56). Much of the writing on Danish immigrants concerns the conflict between rival religious factions, specifically, those supporting the Danish state Lutheran Church and those supporting Indre Mission, a rather radical evangelical movement: this conflict also played out in parts of Denmark (see, for example, Kjær and Larsen 1972).

In an attempt to gain more control of the process of emigration and to prevent fraud by emigration agents, a law was passed in 1868 requiring every emigrant to sign a contract with an emigration agent, which then had to be approved by the police.[11] Although the original contracts no longer exist, the police kept protocols, all of which survived. These protocols were digitized by the Danish Emigration Archives (Det Danske Udvandrerarkiv) in collaboration with Aalborg City Archives (Aalborg

[9] Although, see also Christensen (1924, 1927, 1928) for accounts of Danes who migrated to Iowa, Minnesota, and Wisconsin, respectively, and Brøndal (2013) and Pedersen (1992) for a more general account.

[10] See Lee (1966) for the original theoretical approach to migration.

[11] An exception was Mormons, who often chartered whole ships on their own. These are not included in the data for the years 1873–1894 but also represent a very different kind of emigration that is not relevant for the development of the dairy industry.

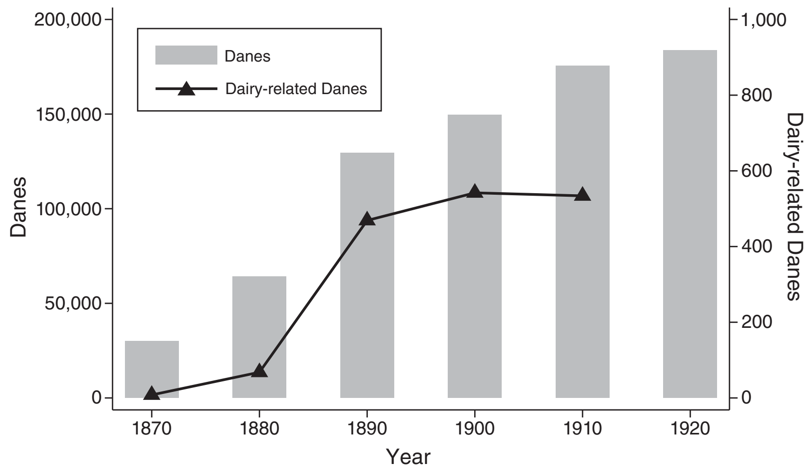


Figure 1. Stock of Danish Immigrants and Flow of Danish Immigrants with a Dairy-Related Occupation

Stadsarkiv) and comprise information on around 330,000 emigrants going from Denmark to the United States between 1868 and 1908, the majority of them Danish but also including foreign emigrants traveling via Denmark, mainly Swedes.[12] The data include the name, birth place and date, occupation, ship traveled on, and destination of the emigrant.[13] Figure 1 shows the total stock of Danish immigrants in the United States (left vertical axis) as well as the number of emigrants from Denmark with an occupation related to dairying (right vertical axis) by year.[14] Especially for Danes with a dairy-related occupation, immigration numbers are very small before 1890—note the difference in scale between the two vertical axes. This pattern arises due to two factors: first, the total number of Danish immigrants was rather low before 1890, but second, and probably more importantly, working in dairying was not initially considered to be an occupation, since men in particular would rather report themselves as farmers.

Although there is some evidence that Danish farmers earned more money in the United States than they did back home (Mackintosh 1992, 1993), Hvidt (1971) argues against the primary role of differences between economic conditions in Europe and the United States in the decision to migrate, and for the importance of various push and pull factors.[15] Although earlier migration was determined by

[12] The data were kindly provided to us by the Danish Demographic Database: Det Danske Udvandrerarkiv. Københavns Politis Udvandrerprotokoller (hosted at Danish Demographic Database, delivery December 2, 2018).

[13] Not all information is always available. Occupation is surprisingly complete with only 103 missing entries, although also often recorded as "child," "housewife," or "worker."

[14] We include the following titles in dairy-related occupations: dairyman (*mejerist* or *mejerimand*), dairy manager (*mejeribestyrer*), dairy owner (*mejeriejer*), dairy consultant (*mejerikonsulent*), dairy worker (*mejeriarbejder*), dairy student (*mejerielev*), dairy tenant (*mejeriforpagter*), dairy apprentice (*mejerilærling*), woman working in dairying (*mejeripige* or *mejerske*), and dairy technician (*mejeritekniker*). For lack of a better translation, we translate *mejerist* with dairyman, although this may be misleading. In Denmark, a mejerist was a person with a large amount of education and a high skill level. Although the other occupations included in the figure do not represent the same level of education, they are all likely to have known about modern dairying techniques.

[15] In an econometric analysis of the reasons for Danish migration to the United States between 1870 and 1913, Larsen (1982) finds economic conditions (for example, employment and wages) in the United States to be more important than those at home.

religious and political motives, the much greater emigration from the 1880s was the result of two factors: first, higher wages in Denmark, and second, lower costs of transportation, both meaning that more people could afford to emigrate. He argues that this was not sufficient, however, since potential migrants needed information about conditions in the United States before they could make a decision. This came first through personal connections: migrant Danes sent generally positive letters back home, and sent money or purchased tickets for their friends and family. Second, shipping and railroad companies (sometimes in collaboration, or private companies acting on their behalf or on behalf of firms looking for labor) advertised heavily, distributed pamphlets, and sent previous migrants to be agents in Denmark. Finally, the United States and state governments themselves advertised in Europe, and Hvidt (1971) cites an example from 1871 of 10,000 pamphlets that were printed in Copenhagen for distribution in Scandinavia. Moreover, there were special newspapers for emigrants with information on emigration and the United States (e.g., *Den nye Verden* 1886–1891, or *Kors og Stjerne* 1889–), and Danish American organizations such as Dansk Folkesamfund (the Danish People's Society) also played a role in the spread of information on the United States—for example, through the distribution of addresses of Danes in the United States one could write to. Finally, returning emigrants also, of course, brought with them information.

### B. *The Modernization of Dairying in Denmark and the United States before the First World War*

At the same time as some Danes were migrating to the United States, something quite remarkable was happening back in Denmark. As is explained by Lampe and Sharp (2019), Danish agriculture, and dairying in particular, had been developing strongly from at least the eighteenth century. This was, however, constrained to "enlightened elites" on large landed estates and was thus largely circumstantial to those who migrated to America, before the invention of the automatic cream separator (a centrifuge). Even before this, however, important innovations were made, including, for example, winter dairying, proved in 1887 but understood prior to that date and widely practiced on estate dairies by the 1860s, with the first exhibition of winter butter in Aarhus in 1868. This greatly increased the productivity of the cows and allowed farmers to take advantage of the relatively high price of butter during the winter (see also Henriksen and O'Rourke 2005). Other innovations included various improvements regarding feeding, breeding, and the artificial cooling of milk to speed up the separation of cream. Danish agriculture also became associated with the production and export of pork, principally bacon, since more efficient separation of cream from the milk left behind a larger amount of waste skim milk, which could then no longer be used for making cheese as had been traditional. It was thus fed to pigs (Henriksen, Lampe, and Sharp 2012).

As for the centrifuge itself, the principle that cream could be separated using centrifugal force was discovered in Germany in 1864, but important refinements were made in the (only recently Danish) Duchy of Holstein in 1876, and the first practical and commercially sold separators based on this design were then produced by rival Danish (Burmeister and Wain) and Swedish (Alfa Laval) firms in 1878 and

1879 (Pedersen 1999, 51). Up to and beyond this date, many important innovations came out of the work of docent Niels Johannes Fjord at the Royal Veterinary and Agricultural College in Frederiksberg, near Copenhagen. He presented the first results of his work with centrifuges in 1879, and established an Agricultural Economic Experimental Laboratory in 1883. Among important later innovations was Fjord's invention in 1887 of a control centrifuge for assessing the butterfat content of milk, which meant that it became possible to pay for milk by quality as well as quantity.

The centralization of production, however, was due largely to the establishment of the separator. Boberg-Fazlic et al. (2023), in a test of Lampe and Sharp (2018), demonstrate that the differential uptake of the cooperative institution and the new technology that they embodied can be traced to a trickle down from the elites who had brought the Holstein System over a century earlier.[16] They find a causal impact on the location of cooperatives established by 1890, as well as the specialization by the peasantry in dairying. The centrifuge meant that it was possible to use milk that had been transported over longer distances to be processed in a central production facility, and led to massive productivity gains. Voluntary associations of Danish peasants, the cooperatives, whereby the butter factory was owned by the milk suppliers, sprang up to take advantage of this possibility. Danish agriculture witnessed extraordinary success, outcompeting traditional leaders in the sector such as the Dutch and the Irish. Within a few years, Denmark had captured a significant share of the important United Kingdom market for animal foodstuffs—for example, almost 50 percent of butter imports by the First World War (Henriksen 1993, 156). In fact, Denmark is still considered an "agricultural superpower,"[17] and dairy production is still dominated by a massive Danish-Swedish cooperative, Arla, which traces its roots back to the developments of the 1880s.

The United States also witnessed considerable progress in dairying before the First World War, although this was understandably less uniform than in Denmark. A useful account of the development of American agriculture in general is provided by Olmstead and Rhode (2008), who argue for an exceptionally dynamic development path founded in science and a stream of biological innovations. In terms of dairying, their story does not sound too different to that in Denmark. They describe a gradual increase in milk yields, mostly due to improvements in feed (especially during the winter months) and shelter, new breeds, and a longer milking season, largely as the result of winter dairying. The Babcock test from 1890, which could measure the butterfat content of milk, is highlighted both by them and by other historians of American agriculture as an important innovation, but as demonstrated previously, this was preceded by a similar invention in Denmark.

Dairying in Europe and North America was clearly separated by long distances, and, initially at least, the perishability of the products meant that Denmark had little

[16] Interestingly, Hvidt (1971) notes that many Danish migrants came from areas with more of the large farms Lampe and Sharp (2018) suggest were so important for facilitating the uptake of modern dairying in Denmark. He attributes this to the fact that estate owners from the 1880s began to grow sugar beet and brought in immigrant labor in particular from Poland to help with this. This put the wages of laborers under pressure, making it difficult for Danish agricultural workers to find enough work, giving an incentive to emigrate.

[17] *Economist*, January 4, 2014, "Bringing Home the Bacon: Tiny Denmark is an Agricultural Superpower."

to fear in terms of competition for the UK market from American producers. This does not mean to say, however, that ideas could not flow across the Atlantic, and indeed they did, as we will discuss more in the next section. But this is not the impression one would get from reading many accounts of the history of American agriculture, although Olmstead and Rhode (2008)[18] note that the world's first dairy herd improvement association was founded in Denmark, and that the Danish immigrant Helmer Ræbild (whom we will return to later) helped found the first association in the United States, in Newaygo County in Michigan, 1906. Neither do histories of cooperation often suggest a significant role for Danish migrants; see, for example, Knapp (1969).[19] However, cooperation was never as important to American agriculture as it was to Denmark, and thus Olmstead and Rhode (2008) consider the introduction of the "factory system" to dairying to be the major advance, since it disconnected the production of cheese and butter from milk and farms. The first butter factory, or creamery, was founded by Alanson Slaughter in Orange County, New York, in 1861. This was more or less contemporaneous with the spread of similar so-called community creameries in Denmark (McLaughlin and Sharp 2021), but clearly the idea of centralizing production at the estate level had been around for much longer in Europe, and besides, it was the centrifuge which was to make possible the central processing of milk for a much larger area, and here Denmark was far in advance. Drejer (1933, 41) (based on an article from the Danish agricultural journal *Ugeskrift for Landmænd*) reports that in 1881 there were already 90 separators in use in Denmark, and that by 1887, the number had risen to about 2,200. As we return to later, the first centrifuge in the United States was imported by Danes and installed in a creamery in 1883.

Cooperatives are even described in some (extremely biased) historical accounts as the "American System of Dairying" (Alvord 1900),[20] but there is certainly no doubt both that Denmark centralized production earlier and that cooperatives earned a greater foothold in Denmark than in the United States. The historical and econometric evidence we present hopefully goes some way toward restoring the recognition due to settlers for the early development of American agriculture, at a time when it lagged significantly behind other countries in some respects. For example, also in productivity terms, there is no mistaking the lead Denmark had over the United States at an early date. As Table 1 demonstrates, Danish milk yields were similar to those in the United States in 1860, although those on the landed estates (consistent with the story presented previously) were already much higher. As the productivity of the cows owned by the peasantry converged on that of the estates, which also continued to increase, the United States was left far behind.[21]

[18] See also Bateman (1968) for an analysis of the determinants of increases in US milk yields over time.

[19] Although, see Danker (1968), who finds a correlation between areas with more Scandinavians and cooperation in agriculture.

[20] The extent to which Alvord neglects the contributions of dairy scientists in Europe is apparent from the following sentence: "The world is indebted to Europe for [the centrifuge], at least as a dairy appliance. It is the only instance in which dairy invention abroad has been notably in advance of the United States" (Alvord 1899, 394). Apart from the Danish contributions we mention here, others such as Louis Pasteur would no doubt beg to disagree.

[21] Leisner (2005) describes how American creameries also introduced pasteurization rather late compared to those in Denmark, largely due to an American demand for a "strong flavor," which was not so easily obtainable using pasteurized milk, which also kept them from the UK market.

Table 1—Milk Yields in Tons per Cow

| | 1850 | 1860 | 1870 | 1880 | 1900 |
|---|---|---|---|---|---|
| Denmark | | 1.1 | 1.5 | 1.8 | 2.5 |
| Danish estates | 1.3 | 1.7 | 1.8 | 2.0 | 2.5 |
| United States | 1.1 | 1.2 | 1.2 | 1.3 | 1.5 |

*Source:* Lampe and Sharp (2019), Table 6.1

### C. *Danes and Dairying in the United States*

The story of the first creamery to use a centrifuge in the United States, founded in the Danish settlement of Fredsville, Iowa,[22] provides nice anecdotal evidence for the way in which knowledge could be transmitted between Denmark and Danish American communities. Truels Slifsgaard from southern Jutland, Denmark, moved to the United States in 1869, where he became a tenant on a farm in Grundy County, Iowa. There was already the cooperative Fairfield Creamery in Cedar Falls, but this was some distance away, and the skim milk he received back was sour and not very useful for feeding pigs, for example, which, as previously noted, was increasingly the common practice among Danish farmers. He learned about developments in Denmark and, in particular, the use of centrifuges through correspondence with his father, Jeppe Slifsgaard (a merchant in southern Jutland), who eventually decided to go to the United States, with a Burmeister and Wain automatic cream separator, together with Niels Blom, a *mejerist*.[23] They arrived in Cedar Falls in the summer of 1882, but the machine was held up by customs in New York, because they did not know if it was made of iron or steel. They finally decided it was made of steel and charged $93 in duties, and this machine thus became the first separator in the United States.[24] Jeppe and Truels Slifsgaard then established "the Danish Creamery" with Niels Blom as *mejerist* in 1883 at the place where Fredsville later grew up.[25] There they used the Burmeister and Wain separator for 11 years, although it caused some difficulties, since it had to be sent back to Denmark for repairs. Other creameries were established using a similar model in the local area, and the Danish Creamery was eventually bought up by the farmers and became a cooperative (Sørensen 1908; Christensen 1957). The US patents for the Burmeister and Wain separator, called the Nielsen separator (after its inventor), were sold to an American firm and given the name "Danish Weston," and later (after some modification) "Reid" (Christensen 1957).[26]

[22] *Fred* is Danish for peace, so literally, "village of peace."

[23] See footnote 14 for explanation.

[24] In fact, the first centrifugal separator in Canada was also imported from Denmark, and was installed in Sainte-Marie de Beauce, Québec (Fondation de technologie laitière du Québec 1985, 476), and the first centrifuge in New Zealand was also imported by a Dane, John Henry Monrad (Sørensen 1908; see also Sundstrom 1986). Danes were even instrumental in the development of dairying (and wider agrarian reform) in Russia, having been explicitly invited to the country for this purpose (Korchmina and Sharp 1920). Danes might thus be seen as having precipitated a global boom in dairy productivity, which it is, however, beyond the scope of the present work to analyze further.

[25] Fredsville only got its post office in 1889.

[26] Denmark itself only offered patent protection from 1894 after signing the Paris Convention for the Protection of Industrial Property (https://www.retsinformation.dk/eli/lta/1894/181). Moser (2005) demonstrates that this lack of intellectual property rights skewed innovation toward inventions that could more easily be protected by secrecy,

The "Danish Creamery" in Fredsville was not the first Danish creamery in the United States, however. That honor belongs to Clarks Grove, Minnesota (which is in fact only just over 100 miles away from Fredsville), where a creamery was established in 1874–1875 as part of a settlement that had its origins in a Danish Baptist colony, established in 1863, both founded by L. Jørgensen Hauge. The creamery struggled for years with low prices for butter, but things began to change when Hauge spent some time at Thorbygaard, Funen, in Denmark in the summer of 1887, where there were 200 cows and a creamery with a centrifuge run on steam power. Hauge came back to Clarks Grove in 1889 and started giving his famous "butter sermons," where he advocated for dairying on Danish principles, which has been considered to have had a strong impact on the development of cooperative dairying in Minnesota. Keillor (2000) argues, however, that this story is somewhat suspect, and that the role of the Danes has been somewhat exaggerated (also because they were well integrated[27]).

It was not only Danish Americans who were of importance, however. These small communities could not possibly have had such a large impact on the entirety of American dairying were it not for their interaction with other migrant communities, as well as native born Americans. Most immediately, although somewhat trivially, Danish Americans settled in proximity to and had a propensity to hire other Scandinavians, with whom they share similar language and culture, and with whom, in the case of Norwegians, they had been in a political union with for centuries until 1814. We later consider this empirically and find evidence supporting the historical narrative. Their influence went far beyond this, however. For example, Edwards (1938) describes how Professor Theophilus Levi Haecker (the son of German migrants, and whose mother was an expert butter maker) is often attributed with improving dairying in Minnesota. While working in 1892 on an extensive survey of dairying in Minnesota, he became familiar with the Danish community in Clarks Grove. According to a later interview with Haecker,[28] he was so impressed by this that he worked on promoting the Danish system of butter production around Minnesota, including through a press bulletin issued by the Minnesota Agricultural Experiment Station in March 1894 on "Organizing Co-operative Creameries," and for over 20 years by direct contact with farmers by traveling between farms. The end result was that from just four cooperative creameries in Minnesota in 1892, by the time of his retirement in 1918, there were no less than 630 (Edwards 1938, 157), and his activities are illustrative of the way in which best practice spread out from Danish communities. This is not, of course, to say that subsequent migration of experts from Denmark did not also play an important role, and we will later consider this additional mechanism carefully. By far the most comprehensive coverage

such as optical and scientific instruments, and food processing, and the example she gives is margarine. Despite its important role for food processing, there is no evidence that the cream separator, a relatively simple centrifuge, was difficult to imitate, and its rapid spread throughout Denmark and later through Danes abroad reflects more a longer tradition of sharing knowledge about new agricultural techniques in Denmark (Lampe and Sharp 2018).

[27] Although, see Jørgensen (1993), who argues that there were many examples of Danish settlements who preserved a strong Danish identity even with a relatively small population.

[28] Interview with Professor Haecker; *Hoard's Dairyman*, 69:14, 23 (January 16, 1925); *Farmer*, 39:1395, 1403, 43:35 (October 8, 1921, January 10, 1925)—cited by Edwards (1938).

of notable Danish Americans and their impact on American dairying is provided by Sørensen (1908).[29]

In sum, Sørensen (1908) argues that Danes were particularly successful in many aspects of dairying. Articles from Danish contributors were a frequent occurrence in American journals, many Danes won prizes at butter and cheese exhibitions, and Danish-educated *mejerister* (of which he argues there was an overproduction back in Denmark, although Hvidt 1971 describes this as a "brain drain") had a relatively easy time finding work in American creameries. Many *mejerister* owned creameries, worked for the state as inspectors and consultants, and became teachers and professors. In addition, Danish migrants also produced successful offspring, educated in the United States. He suggests, however, that in other branches of agriculture, although Danes were receptive to new ideas, they were more like followers rather than innovators. But in US dairying, at the time Sørensen was writing, Danish migrants were extremely important, and not just for small-scale cooperative agriculture. For example, when it was established by Viggo F. Jensen from Southern Jutland in 1900, the Continental Creamery Company in Topeka, Kansas, was the largest creamery in the world.[30]

Sørensen (1908) also explains, however, how American agricultural magazines and bulletins contained frequent references to the Danish dairy sector, and how Danish scientific discoveries were quickly adopted in the United States—for example, the work of Bernhard Lauritz Frederik Bang at the Royal Veterinary and Agricultural College in Frederiksberg (near Copenhagen). His method for testing for bovine tuberculosis was already widely used in Wisconsin in 1896, and later around the country.[31] A detailed study of the cross-cultural exchange between Americans and Danes is provided by Keillor (1993), who argues that despite Danish reservations about allowing their technological lead to be exported to the United States, there was little they could do about the export of people and, with them, ideas. He argues that, with some lag due to language, cultural, and climatic differences to which the pure Danish system could not so easily adapt, Danish Americans acted as "brokers" spreading information between the two countries,

[29] In a massive, comprehensive coverage of every aspect of Danish American life published in two volumes and edited by Vig (1908, 1916). He gives a multitude of examples of Danish American entrepreneurs, scientists, and journalists; for example, Johan Ditlev Frederiksen, who managed the American branch of the Danish producer of butter color, rennet, etc.; Christian Hansen's Laboratory in Little Falls, New York, which sold its products to creameries and households around the United States; and John Henry Monrad, who established his own office of the same business in Chicago, from which he became an important figure in American dairying through his regular contact with creameries, by writing for and editing the agricultural press and even working for the Dairy Division of the US Department of Agriculture (USDA). Other examples were the Dairy Inspector for Minnesota, H. T. Søndergaard; the aforementioned Helmer Ræbild, who was employed by the USDA to promote dairy herd improvement associations; and the pasteurization expert Julius Moldenhawer, who did important work on how to supply towns with clean and healthy milk.

[30] Another example mentioned by Sørensen is the Henningsen Produce Company, which, at the time he was writing, was apparently the largest supplier of dairy products in the Northwest and, possibly, all of the United States. Mackintosh (1990) considers Audubon and Shelby Counties in Iowa, finding that around 1920, decades after the first Danish settlement, agriculture still reflected practices brought from Denmark (and Danish ethnic background dominated the influence of any other single factor). These counties contained, however, the Elk Horn settlement, which was the largest settlement of Danes anywhere in the United States. She finds that Danish townships had on average smaller farms and a greater focus on livestock production, milk cows in particular, although the correlation is rather weak.

[31] Bang is best known today for the discovery of *Brucella abortus* in 1897. This gave rise to the contagious Bang's disease (now known as brucellosis), which causes pregnant cattle to abort and undulant fever in humans.

something that was eventually institutionalized as Danes took important positions within American agriculture, government, and academia. This spread of knowledge was supported through various publications. For example, like other immigrants, the Danes established their own foreign language press.[32] A search in the Digital Library of Danish American Newspapers and Journals, maintained by the Museum of Danish America and which we later exploit as an indicator of information flows, provides plenty of evidence about the spread of information about dairying in Denmark and the progress of Danes in the United States through the Danish American agricultural press, as well as, for example, many advertisements for *mejerister*,[33] the latter demonstrating the endogeneity of the later movement of skilled dairymen to the United States. An article from *Dannevirke* dated December 26, 1888, demonstrates, however, that progress was not always smooth:

> What we most need is a Danish dairy. We should really start with that in the spring. And it is probably best if we start from scratch. The reason is that a dairy was actually started a couple of years ago, and it is still waiting and freezing without a roof over its head. (own translation)

The accounts given in the newspapers are, of course, not of a detailed scientific nature, but they did play an important role in terms of describing developments in Denmark and, in particular, the importance of installing a cream separator, which did not necessitate advanced technical skills and was most relevant for the typical farmer. Scientific knowledge did, however, flow between Denmark and the United States, and there are even examples of Danish American creameries in the United States publishing their accounts in the Danish agricultural press (see, for example, Jensen 1897). Lampe and Sharp (2017, 2018, 2019) have argued that the development of bookkeeping and accounting practices and the sharing of results played an important role in the development of the dairying sector in Denmark. Thus, as Sørensen (1908) suggested, both Danish ideas and men flowed into the United States, and although their importance has been disputed, the present work tests their relative and absolute influence.

## II. Data and Empirical Strategy

### A. *Data*

Our main source is US census data. The microdata for the years 1880, 1900, 1910, 1920, where full count data are available, are provided by IPUMS (Ruggles et al. 2018) and give us information on the number of individuals born in Denmark

[32] The first Danish newspaper in the United States was *Den Danske Pioneer*, founded in 1872, followed by *Bien*, from 1880; *Nordlyset*, published in New York from 1880; *Dansk Tidende*, published in Chicago from 1892; *Ugeblad*, published in Tyler, Minnesota; and *Lutheransk Ugeblad*, the official organ of the United Danish Lutheran Church, published in 1919 (Furer 1972, 50).

[33] One of the earliest found can be read in *Dannevirke*, September 19, 1888, looking for a *mejerist* educated in Denmark.

(and other nations) in each county.[34] Thus, our measure of Danes includes men and women born in Denmark, not their descendants (although we consider second-generation Danish immigrants in a robustness check). Additionally, the microdata include information on the sector and, if in manufacturing, also the industry the individual is working in. We use these data to calculate the number of people working in the dairy industry (manufacturing) as a measure of modernity of the dairy sector. We calculate these figures at the county level. We also use the microdata from 1880 to examine whether Danes were different from other migrants or those born in the United States.

We combine this with data from the agricultural census for the years 1870, 1880, 1890, 1900, 1910, and 1920 at the county level, compiled by Haines (2010), which collect information on the number of animals kept and the produce of each farm (see also Haines, Fishback, and Rhode 2018). The main variable used from this information is the number of dairy cows, defined as cows kept mainly for milk. As of the census of 1850, cattle were classified into three categories: working oxen, milk cows, and other cattle. With increasingly different uses of cattle, this classification was changed to eight categories in 1900: calves under one year, steers between one and two years of age, steers between two and three years of age, steers three years and over, bulls one year and over, heifers between one and two years of age, cows kept for milk two years and over, and cows and heifers not kept for milk two years and over. However, heifers between one and two years were generally counted as dairy cows, i.e., they were kept mainly for milk, and from 1920 counted as a separate category. Therefore, our measure of dairy cows includes "milk cows" before 1900 and cows kept for milk two years and over, and dairy heifers between one and two years after 1900. Additionally, we use information on the number of bushels of wheat produced by county from the census. In 1870 this is divided into spring and winter wheat, which we sum to obtain the total amount of wheat produced as reported for the other years.

The census data also include information on the amount of butter produced. Before 1880, more or less all butter was produced on farms, and we thus only have this figure for the year 1870. After 1870, the industrial production of butter increased in importance and is included in the industrial census from the year 1880, although this is only available on the state level.[35] We thus have the amount of butter produced on farms on the county level and the amount of butter produced industrially on the state level. This leaves us with three main outcome variables (number of cows, workers in industrial dairying, and butter produced), where the number of cows is reported for most years and most consistently across time and space and thus constitutes our main outcome variable. The 1900 agricultural census provides a helpful historical overview of the dairy industry in the United States, noting that it was only around 1875 that farmers began skimming milk and delivering the cream to butter factories, and that the centrifuge had only recently been introduced from Europe, thus

[34] Full count microdata of the 1890 census are not available. Moreover, before 1880, extremely small numbers of Danes are recorded in the census.

[35] Although statistics prior to 1880 are reported in the census of manufactures, these explicitly refer to the data from farms from the agricultural census, according to the original reports.

explaining why the workers and produce of butter factories are only recorded from 1880. Moreover, butter produced on the farms is, according to the report, only reliably recorded from 1900, when, as in previous years, enumerators had a tendency to report cows "not kept for milk" so as not to be responsible for including unreported dairy produce, which was often consumed on the farm. It was, however, decided that year to send out "many thousands of letters" to farmers who had reported cows with no milk, and the responses helped to improve the statistics (p. clxxviii). This was a long-running issue, noted already in the 1880 census (p. xvi). Although data concerning butter produced on the farm and the number of cows are in principle available from 1850, we begin our analysis in 1870 and keep our geographical coverage consistent from this date. A number of states important for Danish settlement (including Minnesota and Nebraska) were only admitted to the Union in the 1850s and 1860s. We discuss this issue in more depth in Appendix B.

We control for the the suitability index for pasture (suitability of global land area for pasture, FAO) provided by the Food and Agriculture Organization of the United Nations (FAO) in all regressions, which is the best indicator for suitability for dairying in the nineteenth century, when most cows would still have been fed on grass. We use the category "low-input-level rainfed" to measure suitability as realistically as possible, given the technology of our time period, and calculate the share of county area classified into high or very high suitability.

We further add a number of geographical variables on the county level, which have been shown to be positively related to economic productivity. We use the suitability index for wheat (crop suitability index (class) for low-input-level rainfed wheat, FAO) in the same way as the pasture suitability described previously. Additionally, we use a measure of terrain ruggedness based on the "Terrain Ruggedness Index" (in millimeters), which is provided by Nunn and Puga (2012).[36] Furthermore, we calculate average county elevation based on the data from GTOPO30 (US Geological Survey 1996). In order to control for market accessibility, we include the distance to the nearest canal or steamboat-navigated river based on the maps provided by Atack (September 2015, March 2017).[37] To calculate the geographical control variables on the county level, we use the shapefile of US historical counties provided by Siczewicz (2011).

Finally, we also use the Danish police protocols on emigrants described earlier. These were provided by the Danish Emigration Archives and Aalborg City Archives (Det Danske Udvandrerarkiv 2018). We use these records to calculate a measure of the direct effects of immigration by calculating the number of Danish migrants who record having worked with dairying in Denmark. We also use the emigration records to provide a measure of knowledge transfer by calculating how many Danish Americans also spent time back in Denmark. We supplement this with information from the Danish-language press in the United States. Copies of these newspapers are available online from the Museum of Danish America.[38]

[36] Downloaded from www.diegopuga.org/data/rugged/tri.zip.

[37] We use this measure as it is clearly exogenous. Our results are robust to including the more general measure of "market access" by Donaldson and Hornbeck (2016), which includes other modes of transportation (railroads and wagons).

[38] See https://box2.nmtvault.com/DanishIM/jsp/RcWebBrowse.jsp.

The main analysis is conducted at the county level. Of course, county boundaries were changing over time, as new counties were formed and others were abandoned. We use stable units of analysis by adjusting all county borders to the year 1870 using the procedure suggested by Hornbeck (2010). In the end, we have data on all variables used in all years for a total number of 2,159 counties.[39] Table A1 in the Appendix provides summary statistics for the main variables.

## B. *Empirical Strategy*

In order to identify the effect of Danish communities on the local dairy industry, we implement a difference-in-differences analysis. We compare the development of the dairy industry in counties that received many Danes with those that received no or only few Danes. Further, we hypothesize that we would see this effect only from 1890. We measure the development of the dairy industry in two different ways. First, we look at whether an area specialized in dairying by using the number of dairy cows (defined as earlier described) in the county as the outcome variable. Second, we investigate the state of modernization in the dairy sector. Here, we have two possible indicators of more modern dairying. As one indicator, we use the number of people working in industrial dairying. The more modern the dairy sector in an area, the more people should work in industrial dairying (as opposed to dairying conducted on farms). This outcome variable is only available from 1880, as industrial dairying was minimal prior to this date, and we expect a positive effect of Danes on industrial dairying. As the second indicator for modern dairying, we use the amount of farm butter produced in the county, with the expectation that this should be falling over time as production moved into the factories.

As the treatment variable, we use the distribution of Danes in 1880. The main innovations we are interested in took place during the 1880s: the first steam-powered cream separator was installed in 1878 in Denmark, and the first cooperative creamery in Denmark was established in 1882. The first cream separator in the United States was installed in the Danish cooperative creamery in Fredsville, Iowa, in 1883. We use the distribution of Danes prior to these dates, i.e., the distribution in 1880, as this will ensure exogeneity with respect to these events. The developments in the Danish dairy sector happened rapidly over the course of just a few years. Danes emigrating before or in 1880 could not possibly know that Denmark would have an advantage in dairying just one decade later. Only by 1890 would Danes have learned about cooperatives and new technology in butter production by still keeping contact with their home country. Whether a county has resident Danes should thus only matter from 1890 and onward, where we expect to see an effect of Danes on the local dairy sector. As explained earlier, the absolute number of Danes coming to the United States was small compared to other European countries; however, it may not need many Danes to bring technological knowledge to an area. Technology spreads between people such that even one person with the right knowledge may have a

[39] Using the 1870 counties implies that we do not include territories that only acquired statehood after this date, although see Rogers (1978) on "Creamery Fever" among Scandinavians in Grant County, South Dakota before the First World War.

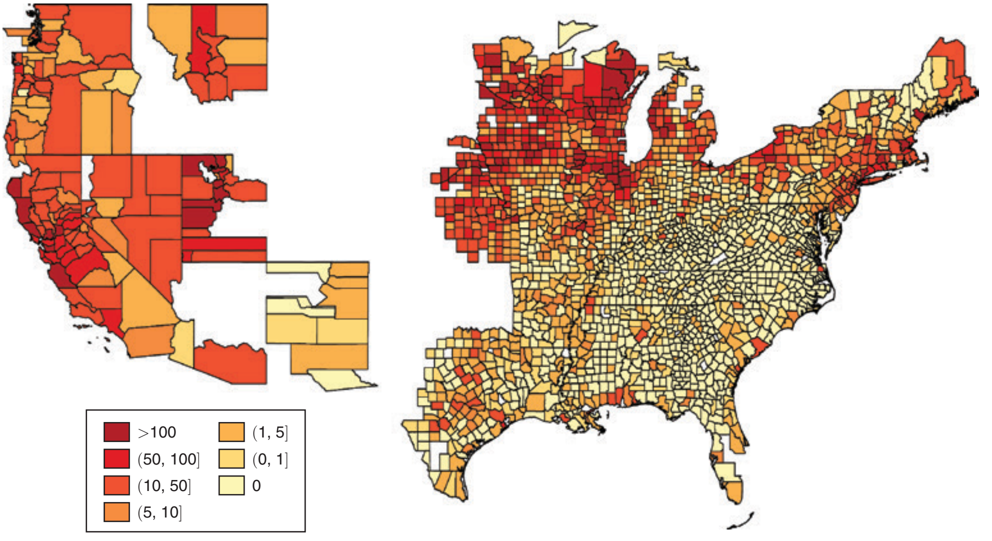


Figure 2. Number of Danes per County in 1880

great impact. We thus measure the predetermined distribution of Danes by taking the natural logarithm to the number of Danes in the county in 1880.[40] Figure 2 presents a visualization of where Danes settled over time. In 1880, Danes are highly concentrated in the Midwest and the Mormon colonies of Utah.

One potential threat to our identification strategy is that Danes already before 1890 might have exhibited certain traits that would give them an advantage in dairying. Although they could not possibly know about modern dairying techniques, they could be better educated than others, for example. Based on the microdata from the 1880 census, Figures A1 and A2 in the Appendix show a comparison of several characteristics across different nationalities, to investigate whether Danish settlers in 1880 were different from other settlers at the time or from those born in the United States. None of these variables show Danes to be particularly different from other immigrant groups or natives. Also, although we see no evidence that this might be the case since the best pastoral land is located in the east of the country, a concern might be that Danes settled in areas particularly suited for dairying or less suitable for industry, for example. This issue is also discussed by Ottinger (2020), who controls for measures of inherent natural advantage. His identification strategy makes use of variation in climatic shocks in the country of origin. As Denmark is geographically very small, this would make little sense in our context. We nevertheless, as mentioned earlier, control for the suitability for pasture (and other geographical characteristics) in all regressions. Table A2 in the Appendix shows the correlations of the distribution of Danes with the geographic controls. In fact, Danes settled in areas less suitable for pasture and more suitable for wheat. Many Danish settlers were working in agriculture, and they were likely to have worked in arable

[40] We prefer the specification in logarithms, as the distribution of Danes in 1880 is highly skewed to the left. Section IIIC shows that the results are robust to alternative functional forms.

agriculture in their home country before migration. The observed settlement pattern therefore makes intuitive sense and actually works against our findings.[41]

We estimate the following standard difference-in-differences models to determine the average treatment effect:

$$(1) \qquad Y_{it} = \beta \ln\left(Danes_{1880i}\right) \times D_{post1880} + \sum_{j=1870}^{1920} \mathbf{X}_i \times I_j + \mu_i + \lambda_t + \eta_{rt} + \epsilon_{it},$$

where $Y_{it}$ is one of our outcome variables $\ln\left(cows_{it}\right)$, $\ln\left(ind.dairy_{it}\right)$, or $\ln\left(farmbutter\right)_{it}$ for county/state $i$ at time $t$. $\ln\left(cows_{it}\right)$ is the natural logarithm of the number of dairy cows, $\ln\left(ind.dairy_{it}\right)$ the natural logarithm of the number of people working in industrial dairying, and $\ln\left(farmbutter\right)_{it}$ the natural logarithm of pounds of butter produced on farms (i.e., traditionally). $\ln\left(Danes_{1880i}\right)$ is the natural logarithm of the number of Danes in 1880 in county $i$, and $D_{post1880}$ is an indicator variable that takes the value zero in and before 1880, and one in 1890 and thereafter.[42] The vector $\mathbf{X}_i$ represents time-invariant control variables interacted with year fixed effects. Here, we include geographical characteristics of the county to account for the possibility that it is not Danes having an effect on the dairy industry, but that Danes may settle in areas with a geographical advantage for dairying or for industrial development in general (see also Nunn and Qian 2011). The predetermined suitability for dairying is controlled for by including the share of county area with high or very high pasture suitability.[43] We also include the average elevation, the average Terrain Ruggedness Index of county area (measured in millimeters), and the share of county area with high or very high wheat suitability to account for general agricultural suitability. To control for suitability for industrial production, we control for the distance to a canal or steamboat-navigable river. Further, we include county fixed effects ($\mu_i$), time fixed effects ($\lambda_t$), and region-by-year fixed effects ($\eta_{rt}$). Including region-by-year fixed effects implies that we are comparing counties that received Danes in or before 1880 to counties without Danes within the same region. $\epsilon_{it}$ is the error term, clustered at the county level. Our main parameter of interest is $\beta$, the average treatment effect. In the Appendix, we also estimate a flexible difference-in-differences model, including dummy variables for each year, using 1880 as the baseline year. The flexible model allows us to investigate the common trend assumption that the treated counties are not on a diverging path to more (modern) dairying prior to treatment. However, we can only estimate this for $\ln\left(cows_{it}\right)$ and $\ln\left(farmbutter_{it}\right)$, since the other outcome variable is only available from 1880.

[41] This is even the case when we look at counties with more than three Danes in 1880 only. Many counties had zero Danes in 1880; however, this seems not to be related to the prevalence of land suitable for pasture versus wheat.

[42] In case a variable takes the value zero, we add a small amount to take the logarithm. In Section IIIC, we show that our results do not depend on this assumption. We prefer the analysis in levels, as Danes often moved to rather unsettled areas, such that the number of Danes as a share of population becomes less meaningful in this case. Also, we hypothesize that it is not necessarily the size of the group of Danes that is important. Nevertheless, Section IIIC also shows results for different treatment variables.

[43] The results are robust to including also medium levels of pasture suitability or only very high suitability levels.

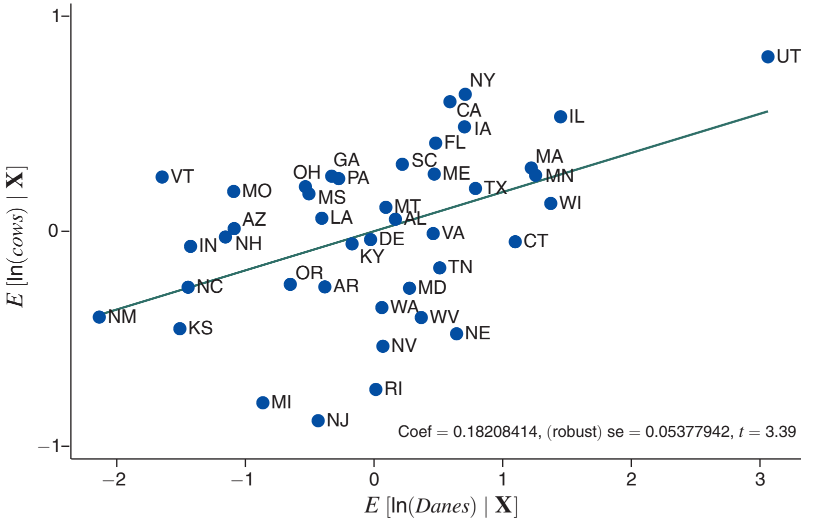


Figure 3. Partial Regression Plot between ln(*Danes*) and ln(*cows*). State Level, Year 1900

## III. Results

### A. *Specialization and Modernization*

We start with a simple pooled OLS estimation for the years 1890 to 1920, as we only expect a relation between the number of Danes and the number of dairy cows after 1890. Figure 3 shows the partial correlation between the number of Danes and the number of dairy cows, including the full set of control variables. For better visibility, we show this at the state level and only for the year 1900 here, where, however, some persistence of the settlement patterns identified in Figure 2 is apparent. The same figure based on all data points, i.e., all counties for the years 1890–1920, can be found in Figure A3 in the Appendix.

Clearly, there is a positive relation between the number of Danes and the number of dairy cows. Of course, this result can by no means be interpreted as a causal relationship. Therefore, we present results from a difference-in-differences model using the distribution of Danes in 1880 as the treatment variable and 1880 as the cutoff year. We estimate the average treatment effect for the three different outcome variables, $\ln(cows)$, $\ln(ind.dairy)$, and $\ln(farmbutter)$, presented in Table 2.

There is a strong positive effect of Danes on dairy cows after 1880, such that places receiving more Danes up to 1880 developed more strongly in dairying in subsequent years. This finding is supported by column 2, where we also find a positive effect on the number of people working in industrial dairying, indicating more modern dairying techniques. Another way to look at the state of modernization of the dairy sector is to look at the amount of butter produced and, especially, whether this butter is produced on farms (the traditional way) or in modern factories/creameries (industrial butter). Column 3 shows that Danes have a negative effect on the amount of butter produced on farms, which represents the

Table 2—Difference-in-Difference Estimation

| | ln(*cows*) (1) | ln(*ind.dairy*) (2) | ln(*farmbutter*) (3) |
|---|---|---|---|
| $post1880 = 1 \times \ln(Danes1880)$ | 0.009 | 0.076 | −0.005 |
| | (0.002) | (0.021) | (0.002) |
| Year FE | Y | Y | Y |
| County FE | Y | Y | Y |
| Region × year FE | Y | Y | Y |
| Geography × year FE | Y | Y | Y |
| Observations | 12,954 | 8,636 | 12,815 |
| Number of counties | 2,159 | 2,159 | 2,159 |

*Notes:* Geography controls include the natural logarithm of the share of county area with high or very high pasture suitability, the share of county area with high or very high wheat suitability, average elevation, average Terrain Ruggedness Index of county area (measured in millimeters), and the distance to a canal or steamboat-navigable river. Robust standard errors in parentheses, clustered at the county level.

more traditional method for producing butter. Ideally, we would like to contrast this with the amount of butter produced in industry, but unfortunately this information is not available at the county level. At the state level, however, this distinction is available. We digitize the amount of butter produced in industry from the manufacturing censuses for the years 1880, 1890, 1900, 1910, and 1920 (US Census Bureau 1883, 1895, 1902, 1913, 1928). Table A3 in the Appendix shows the effect of Danes on the total amount of butter produced (column 1), the amount of industrial butter (column 2), and the amount of butter produced on farms (column 3). Overall, we find an insignificant negative effect of Danes on total butter, where the coefficient is effectively zero compared to the coefficients estimated in columns 2 and 3. When we split the butter into modern and traditional production, however, we see diverging effects between industrial butter and butter produced on farms. As industrial production was still rather limited (as are our number of observations, since these data are only available on the state level), it is not surprising that the coefficient in this specification is not significant. Nevertheless, the results indicate that areas with more Danes produced more industrial butter where they at the same time produced less butter on farms, with the implication that resources were diverted toward industrial production away from the more traditional methods in these areas.

Focusing on column 1 in Table 2, our average treatment effect is an elasticity of 0.009. This means that 1 percent more Danes led to 0.009 percent more dairy cows after 1890. This effect is not negligible, as the average number of dairy cows is almost 200 times the average number of Danes in the county before 1890 and still more than 100 times after 1890. Thus, an increase in the number of Danes of 1 standard deviation above the mean translates to 4.2 percent more dairy cows. Moreover, the effect is most likely underestimated, as we use the distribution of Danes in 1880 as our treatment variable. Danish migration first took off in the 1890s, and we are thus assigning zero to many areas that later received Danes. Moreover, we demonstrated earlier that the effect was bigger on the intensive margin. Nevertheless, despite rather small Danish migration streams, we find a significant positive effect, thus demonstrating that areas with Danes specialized in dairying and kept a greater number of dairy cows.

### B. *Flexible Difference-in-Differences and Persistence*

The difference-in-differences model rests on the common trend assumption, which states that in the absence of treatment, the difference in the outcome variable between counties in the treatment group (counties receiving Danes) and counties in the control group (those not receiving Danes) would be constant. One way to test this assumption is to estimate the flexible difference-in-differences model, i.e., to interact the treatment variable with time dummies including pretreatment periods. Since the only outcome variables we have from before the 1880s are $\ln(cows_{it})$ and $\ln(farmbutter_{it})$, we use these to estimate a flexible difference-in-differences model, allowing the effect of the 1880 distribution of Danes to differ in every year. The results are shown in Table B1 in the Appendix. We note a negative pre-trend in the baseline specification, i.e., counties receiving more Danes up to 1880 do in fact have lower numbers of dairy cows in 1870. This pre-trend might suggest a general pattern of convergence unrelated to the presence of Danes. We note, however, that roughly half the counties had no Danish population at all in 1880, and thus convergence of these, and other areas with almost no Danes, might be one explanation. Indeed, in Appendix B we investigate this more formally and find that the pre-trend disappears when conditioning on "significant" numbers of Danes, i.e., two or above. For ln $(farmbutter_{it})$ there is no pretrend, and in fact, if anything, the coefficient for 1870 suggests that Danes located to areas with less butter production. After 1880, areas with more Danes witnessed more rapid declines in farm butter production than those with fewer Danes.

In the same vein, we might wonder whether places where Danes originally settled are still relatively specialized in dairying. Indeed, Ottinger (2020) finds surprisingly persistent patterns of industrial location until today. From Haines (2010) we also have data on the number of dairy cows for the years 1950, 1960, and 1970, and we add these years to the flexible difference-in-differences model, with our results again presented in Appendix B. We find strong persistence in dairy specialization: areas that started to specialize in the very early days of dairying still seem to do so today. The fact that the coefficient actually increases could be due to consolidation of the industry, especially in the later years. Today, only a few states produce large amounts of dairy products, which explains the very large standard errors on the estimates. Thus, in particular, areas in the Midwest, which is exactly where many Danes settled originally, are strong dairy producers. In the long run, states receiving more Danes in 1880 still specialize in dairying almost 100 years later.

### C. *Robustness*

We have shown that areas that received more Danes specialized in dairying and also conducted more modern dairying. To test the empirical power of our treatment variable, the 1880 distribution of Danes, we randomize this distribution across counties. We repeat this exercise 10,000 times and use each random distribution as the treatment variable in equation (1) instead of the true distribution. The *t*-values for the estimated treatment effects are presented in Figure A4 in the Appendix. As a reference, a line is added for the *t*-value from our preferred estimation (column 1 in Table 2). Clearly, the true distribution of Danes in 1880 explains dairy cow numbers far better than any random draw. Moreover, the unit of analysis used here is the county, the borders of which are of course somewhat arbitrary. This may raise concerns about spatial correlation biasing our results. We therefore present estimates employing Conley standard errors using different cutoff points in Table A4 in the Appendix.[44] The standard errors, and thus the significance of our results, are only marginally affected even by the largest cutoff of 500 kilometers. This implies rather little spatial correlation in the error terms and thus only little spillover effects between counties located close to each other. However, counties were relatively large compared to the size of settlements. Grundy County in Iowa mentioned earlier, for example, covers an area of 337 square miles. The size of Racine County in Wisconsin, which had the highest number of Danes in 1880 after Chicago and Sanpete County in Utah (receiving mainly Mormon migration), was 228 square miles. These are relatively small counties, as the average county covered 630 square miles, but nevertheless imply traveling substantial distances to go from one county to another.

One might, of course, also question our treatment variable. In the main specification, we use the natural logarithm of the number of Danes by adding a small value to the zeros, so that we can compare counties who received Danes to those that did not. Table 3 shows that our results are robust to not adding a small value to the zeros (and thus excluding observations), to different small values, and to an inverse hyperbolic sine (IHS) transformation. As mentioned earlier, we prefer the specification in logarithms as the distribution of Danes in 1880 is highly skewed to the left. We could, however, also use a different functional form for the measurement of Danes.[45] Table 4 presents results when weighting the regression with population in 1880 (column 2), using Danes by total population (column 3) or an indicator variable for whether a county has Danes in 1880 (column 4). When including each variable by itself, we find a significantly positive effect of Danes on dairy cows in all specifications. We also include second-generation Danes as an additional explanatory variable in column 5, although only the first generation seems to matter. Jeppesen (2016), for example, notes that Danish migrants quickly integrated into American society. Thus, especially the first generation is expected to keep contact with the home country, which could explain why we only find an effect from first-generation migrants. When including all measures in a horse race specification (column 6), only the logarithm of Danes and the population share of Danes remain positive. The former remains our preferred specification, since it avoids the biases that would be introduced by including population both on the left- and right-hand sides of the regression equation.

It could also be that Danes were just very good at agriculture, including dairying. Columns 1 and 2 of Table A5 in the Appendix, therefore, present a placebo regression using wheat and number of sheep in a county as the outcome variable. In both cases, we find an insignificant although positive effect on the amount produced. We cannot therefore reject that Danes were at least as good for wheat or sheep production as for dairying, although the relationship is less robust. We thus look for other indicators

[44] The estimation is based on code written by Fetzer (2014) and Hsiang (2010).

[45] Although these do not fit the assumption of a linear relationship to the outcome variable $\ln(cows)$ very well.

TABLE 3—ALTERNATIVE TRANSFORMATION OF *DANES*1880

| | ln(*cows*) $\varepsilon$ = 1e-08 (1) | ln(*cows*) $\varepsilon$ = 0 (2) | ln(*cows*) $\varepsilon$ = 1e-09 (3) | ln(*cows*) $\varepsilon$ = 1e-06 (4) | ln(*cows*) IHS (5) |
|---|---|---|---|---|---|
| *post*1880 = 1 × ln(*Danes*1880) | 0.009 | | | | |
| | (0.002) | | | | |
| *post*1880 = 1 × ln(*Danes*1880) | | 0.042 | | | |
| | | (0.012) | | | |
| *post*1880 = 1 × ln(*Danes*1880) | | | 0.008 | | |
| | | | (0.001) | | |
| *post*1880 = 1 × ln(*Danes*1880) | | | | 0.011 | |
| | | | | (0.002) | |
| *post*1880 = 1 × *Danes*1880_*ihs* | | | | | 0.063 |
| | | | | | (0.011) |
| Year FE | Y | Y | Y | Y | Y |
| County FE | Y | Y | Y | Y | Y |
| Region × year FE | Y | Y | Y | Y | Y |
| Geography × year FE | Y | Y | Y | Y | Y |
| Observations | 12,954 | 7,764 | 12,954 | 12,954 | 12,954 |
| Number of counties | 2,159 | 1,294 | 2,159 | 2,159 | 2,159 |

*Notes:* Geography controls include the natural logarithm of the share of county area with high or very high pasture suitability, the share of county area with high or very high wheat suitability, average elevation, average Terrain Ruggedness Index of county area (measured in millimeters), and the distance to a canal or steamboat-navigable river. Robust standard errors in parentheses, clustered at the county level.

TABLE 4—ALTERNATIVE TREATMENT VARIABLES

| | ln(*cows*) (1) | ln(*cows*) weight = *pop*1880 (2) | ln(*cows*) (3) | ln(*cows*) (4) | ln(*cows*) (5) | ln(*cows*) (6) |
|---|---|---|---|---|---|---|
| *post*1880 = 1 × ln(*Danes*1880) | 0.009 | 0.008 | | | 0.008 | 0.034 |
| | (0.002) | (0.001) | | | (0.002) | (0.014) |
| *post*1880 = 1 × *Daneshare*1880 | | | 12.406 | | | 9.219 |
| | | | (4.323) | | | (4.086) |
| *post*1880 = 1 × *Danes_present* = 1 | | | | 0.144 | | −0.513 |
| | | | | (0.031) | | (0.266) |
| *post*1880 = 1 × ln(*secondg*1880) | | | | | 0.001 | −0.003 |
| | | | | | (0.002) | (0.002) |
| Year FE | Y | Y | Y | Y | Y | Y |
| County FE | Y | Y | Y | Y | Y | Y |
| Region × year FE | Y | Y | Y | Y | Y | Y |
| Geography × year FE | Y | Y | Y | Y | Y | Y |
| Observations | 12,954 | 12,954 | 12,954 | 12,954 | 12,954 | 12,954 |
| Number of counties | 2,159 | 2,159 | 2,159 | 2,159 | 2,159 | 2,159 |

*Notes:* Geography controls include the natural logarithm of the share of county area with high or very high pasture suitability, the share of county area with high or very high wheat suitability, average elevation, average Terrain Ruggedness Index of county area (measured in millimeters), and the distance to a canal or steamboat-navigable river. Robust standard errors in parentheses, clustered at the county level.

of specialization in dairying. In Denmark, a specialization into pork production occurred along with the specialization in modern dairying. In line with this, we also find a positive effect of Danes on the number of pigs kept in a county; see column 3 of Table A5 in the Appendix—another indicator for the modernization of the dairy sector. In column 4 we present results on the number of cattle in a county. The effect is positive and significant. This is not surprising because, naturally, some nondairy cattle are usually kept together with cows. The coefficient, however, is smaller than on dairy cows, a result that is also reflected by column 5, which uses the ratio of dairy cows to nondairy cattle as the outcome variable. This finding supports the notion that areas with more Danes in 1880 are associated with a specialization of cattle into dairying. Finally, column 6 investigates whether Danes had a general impact on the value of agricultural land.[46] We do not find this to be the case, but this is not surprising. As noted previously, American agriculture in general was exceptionally innovative during this period, and dairying constituted just one part of this.

Further robustness checks are provided in Table A6 in the Appendix, which provides specifications including additional control variables. As is evident from Figure 2, a large share of Danes emigrated to counties in the Midwest. This is also where many of the early dairy cooperatives started and where a large share of dairy production still is located. For example, one of the largest dairy producers in the United States today, the cooperative "Land O'Lakes," is based in Arden Hills in Minneapolis. We therefore check whether identification stems from the Midwest versus the rest of the country receiving very few Danes or whether our results also hold true within the Midwest. When repeating our analysis for counties in the Midwest alone, in fact, we also find a significantly positive effect of Danes, which is even larger than in the baseline specification. Our estimation results can be found in column 1 in Table A6. This means that also within an area receiving many Danes, counties that received more Danes specialized more in dairying than counties receiving fewer Danes.

In column 2 we control for counties lying in the "frontier." It could be that our results simply stem from Danes settling in the frontier, which then catches up in terms of agriculture over the next decades. We therefore include a dummy variable for all counties lying in the frontier (or "wilderness") in 1880. Here, we use the contemporary definition of the frontier of the US Census Bureau, defining areas with fewer than two inhabitants per square mile as "wilderness" and between three and six inhabitants as "frontier" (see also Turner 1920). Our results are unchanged. As mentioned earlier, many of the early Danish migrants were Mormons. As these were very different from the Danish settlers, we use the per capita number of Mormon organizations in the county from the 1870 census to control for these very different types of settlements in column 3. Again, our main results are unaffected. In column 4, we include the natural logarithm of initial population (year 1870) interacted with time, as it may be population in general rather than Danes fostering economic development in the area. In fact, the estimated effect of Danes increases in size and is unaffected in terms of sign and significance. Similarly to Ottinger (2020), column 5 controls for market access, a county-level measure based on the network of railroads, waterways, and lowest-cost freight routes, as provided by Donaldson and Hornbeck (2016). Market access would be important for transporting the dairy produce to cities and might thereby have influenced the location of industry.[47] Our main estimate is unaffected. In column 6, we

[46] We calculate this as the cash value of farms divided by the number of acres of improved farmland.

[47] Note, however, that this measure may also be endogenous. We therefore use the 1870 level of the variable to account for the "predetermined" level of market access.

also control for resource region fixed effects (interacted with time). Here, we use land resource regions as defined by the United States Department of Agriculture (2006). Our estimate is also robust to this control. Column 7 introduces the additional geographical controls jointly, and again the main estimate is unaffected.[48]

## D. *Mechanisms*

We argue that we present a very specific example of knowledge transfer through migrant communities, although it is of course impossible to actually measure this transfer. Nevertheless, we can investigate the mechanism further—considering in particular whether the effect is due to the transfer of knowledge or the transfer of people. Our hypothesis is that this was principally a transfer of knowledge. One reason for believing so is that the absolute number of Danes is simply too small for the people alone to have made a difference. Already by 1890 every single Dane in the country would have had to produce more than 1,000 pounds of industrial butter if our results were only due to the people arriving.[49] Furthermore, we hypothesize that all Danes are potential transmitters of knowledge.

Along this line, we investigate whether the effect stems from dairy-related Danes more than from "regular" Danes, as we have information on the occupation from the Danish emigration data. We calculate the number of Danish immigrants with a dairy-related occupation[50] per county. This is possible as the majority of migrants record the exact settlement they travel to. In total we have information on 1,621 Danes working in dairying, which represents less than 1 percent of all emigrants from Denmark to the United States. All Danes could be potential transmitters of knowledge, however. In principle, all Danes would be observing changes in dairying practices, as the transformation of the dairy sector in Denmark happened so rapidly and "radically." Potentially least informed would be emigrants from urban areas, especially from Copenhagen. Interestingly, three-fourths of emigrants from Copenhagen move to an urban destination in the United States (defined as one of the ten largest cities in the United States in 1880[51]). Thus, the emigrants with the least potential knowledge also went to the least relevant areas in the United States.

Using the data from emigration records, we can also calculate the number of Danes traveling back to Denmark—an indication of the contact kept to the home country and thereby a measure of knowledge transfer. Here, we calculate the number of Danes traveling from Denmark to the United States, stating the United States as their last place of residence. This will include people born in the United States

[48] Our results are not robust to the inclusion of longitude and latitude. Given our difference-in-differences specification, we have to interact these measures with time. This makes the results difficult to interpret but also controls for very fine-grained geographical fixed effects over time. As the main concern is whether Danes settled in areas particularly suited for dairying, we find the results presented in Table A6 address this concern in a more intuitive and interpretable way.

[49] This also speaks against a story of Danes simply increasing the demand for dairy products. Moreover, Danish production at home was largely driven by demand from the United Kingdom rather than domestic demand, which was often met by cheap substitutes; see Lampe and Sharp (2014, 2015).

[50] See footnote 16 for a list of occupations.

[51] These include New York, Boston, Philadelphia, Chicago, St. Louis, Baltimore, Cincinnati, San Francisco, and New Orleans.

traveling to Denmark and back, as well as people born in Denmark who have emigrated to the United States and then travel back and forth.

As another measure of knowledge transfer, we use the fact that Danes who emigrated to the United States set up their own newspapers to spread information. The most important Danish newspapers were *Bien* (San Francisco, California), *Danskeren* (Blair, Nebraska), *Dannevirke* (Cedar Falls, Iowa), and *Den Danske Pioneer* (Omaha, Nebraska). As a first measure, we calculate the sum of the inverse distances of each county midpoint to the locations of publication of the four Danish newspapers—$\ln(distNews)$—as a very rough proxy of access to information in Danish. As an attempt to measure more relevant information, however, we also use the digitized versions of these from the Museum of Danish America to calculate the number of times they mention "dairying": this may be articles about dairying or dairymen, or also job advertisements.[52] We aggregate the number of mentions by newspaper and by decade and weight the inverse distance of the county midpoint to the place of publication by the number of mentions. This gives us a measure of "dairy newspaper coverage" on the county level, measuring how close a county is to the publication of a Danish newspaper, adjusted for how often the particular newspaper mentioned dairying, by decade—$\ln(distDairyNews)$.

As extremely few emigrants arrive before 1890, we can only use the variables of dairy-related Danes and Danes traveling back to Denmark, which are based on the Danish emigration data, in an OLS setting. Also, of course, all of the aforementioned measures are highly endogenous and possibly correlated with a confounding factor, most importantly income. One could, for example, imagine that places with higher income would also see higher numbers of traveling Danes, as more people would be able to afford going back and forth to the home country. We therefore control for income, as measured by land value by acre, in all OLS regressions. We have already established in Table A5 that Danes did not have any significant effect on land values, and we can therefore interpret it as a control rather than a mechanism here and also avoid multicollinearity in the regression. The results can be found in Table 5. The emigration data only cover emigrants up to 1908, and thus estimations only include the years 1890–1910. Evidently, all measures have an independent effect. Comparing columns 4, 5, and 6 shows that when including both the pure inverse distance to the newspapers and the inverse distance weighted by the number of "dairy" mentions, only the latter remains significant. This indicates that we are not just measuring proximity to places with many Danes (where also Danish newspapers are more likely to be published) but that the content also matters.[53] In all columns the correlation with the general Danish population is hardly changed by the inclusion of the other variables. Of course, these are pure correlations, which nevertheless indicate that the estimated effect in the main specification cannot be traced to Danes working in dairying alone.

Using the micro-level census data, we can take a closer look at the people working in industrial dairying. Ottinger (2020) makes use of classification as "owner"

[52] In particular we search for the Danish words *mælkeri*, *mejeri*, *meieri*, *mejerske*, and *meierske*. Up to 1910, these words were mentioned 1,316 times in total.

[53] In line with the information transmission channel, an interaction term between the number of Danes in the county and $\ln(distNews)$ is also positive and significant.

Table 5—Pooled OLS Estimation, 1890–1910

| | ln(*cows*) (1) | ln(*cows*) (2) | ln(*cows*) (3) | ln(*cows*) (4) | ln(*cows*) (5) | ln(*cows*) (6) | ln(*cows*) (7) |
|---|---|---|---|---|---|---|---|
| ln(*Danes*) | 0.023 | 0.023 | 0.021 | 0.022 | 0.022 | 0.022 | 0.020 |
| | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) | (0.001) |
| ln(*dairyDanes*) | | 0.015 | | | | | 0.005 |
| | | (0.002) | | | | | (0.002) |
| ln(*travelingDanes*) | | | 0.016 | | | | 0.012 |
| | | | (0.001) | | | | (0.001) |
| ln(*distNews*) | | | | 0.258 | | 0.026 | −0.027 |
| | | | | (0.030) | | (0.055) | (0.056) |
| ln(*distDairyNews*) | | | | | 0.273 | 0.253 | 0.239 |
| | | | | | (0.026) | (0.048) | (0.048) |
| ln(*landvalue*) | Y | Y | Y | Y | Y | Y | Y |
| Year FE | Y | Y | Y | Y | Y | Y | Y |
| Region FE | Y | Y | Y | Y | Y | Y | Y |
| Geography | Y | Y | Y | Y | Y | Y | Y |
| Observations | 6,471 | 6,471 | 6,471 | 6,471 | 6,471 | 6,471 | 6,471 |

*Notes:* Geography controls include the natural logarithm of the share of state area with high or very high pasture suitability, the share of state area with high or very high wheat suitability, average elevation, average Terrain Ruggedness Index of state area (measured in millimeters), and the distance to a canal or steamboat-navigable river. Coefficients are standardized beta coefficients. Robust standard errors in parentheses.

or "manager" among immigrants as proxies for the early entry of pioneer firms in county industries, and demonstrates that pioneer firms were owned by immigrants from countries with the relevant specialization. As touched on earlier, our case is somewhat different. Extremely few Danes settled in the United States prior to 1880, and industrial dairying simply did not exist then and is thus not recorded in the census. We can, however, explore the subsequent period. Figure 4 shows the percentage of (first- and second-generation) Danes, contrasted with the percentage of the total population, all foreigners, (first- and second-generation) Swedes, and (first- and second-generation) Norwegians working in the dairy industry. As expected, Danes are overrepresented, as a higher percentage of the Danish population is involved in industrial dairying. The census also reports the type of position an individual held. We can, for example, distinguish "managers" from the categories "Managers, officials, and proprietors (nec)," "Bookkeepers," "Clerical and kindred workers (nec)," "Salesmen and sales clerks (nec)," and "Foremen (nec)." This information reveals that in 1900, only 6 out of 1,110 "managers" in the dairy industry were Danish, and in 1910, this number increased to 67 out of 4,838. In absolute numbers, but also as a percentage, these figures are very low, which more generally speaks against a transfer of people or human capital and in favor of a transfer of knowledge.

The effect seems to stem from the general Danish immigrant population rather than Danes related to dairying. If it is not the flow of people but rather the flow of ideas we are measuring, others must have worked together with Danes or imitated the way Danes were conducting dairying. Yet, it could be that it was not especially Danes who fostered development in the area, but immigrants in general or another group of immigrants that happens to correlate with Danes. For the latter, especially

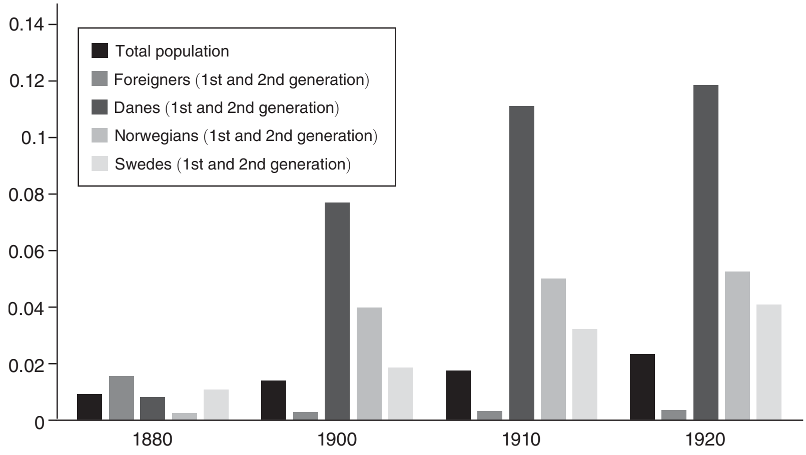


Figure 4. Percentage of Different Population Groups Working in Industrial Dairying

*Source:* IPUMS, 1880, 1900, 1910, and 1920 census

Swedes and Norwegians are relevant. First-generation immigrants were not likely to be proficient in English. Danes, Swedes, and Norwegians would nevertheless understand each other, since the languages are mutually intelligible, and are also culturally closer to each other than other immigrant groups. Information can thus be expected to flow more easily between them. Also, Scandinavians often settled in similar areas and tended to work with each other. In almost 70 percent of the counties with one of the groups present, the other is also present.[54] It is therefore not possible for us to clearly disentangle effects from Danes versus Norwegians. We thus use an aggregate measure of all foreign born people, resembling Sequeira, Nunn, and Qian (2020), as well as the number of Swedes and Norwegians in the county in 1880. Results are presented in Table 6. Column 1 reproduces our main result. Column 2 repeats the same specification using all foreign born people instead of Danes. They have no significant effect on dairy cow numbers in the county, which even turns negative when including both Danes and all foreigners (column 3). Columns 4–6 investigate whether Danes have a separate effect from other Scandinavians (Swedes and Norwegians). Scandinavians have a separate positive effect on dairy cow numbers (column 4), which seems to stem especially from Norwegians (column 5). This positive effect from Norwegians is, however, only present when Danes are present in the county—in counties without Danes, Norwegians also have no positive effect on dairy cow numbers (column 6). Non-Scandinavian foreigners are associated with less dairying, and even more so when Danes are present. This speaks to the impact of foreigners on specialization in other industries, as highlighted by Ottinger (2020).

[54] They might have chosen to settle in the same region due to cultural similarity, but also immigration agencies shaped the settlement patterns, with different agencies being active in different European countries. Often, tickets were sold to a particular destination, and sometimes land was assigned/acquired before the journey. For example, as mentioned earlier, railroad companies bought large areas of land, built the railroad, and then sold slots along the line to new settlers with the result that clusters of immigrants of different nationalities formed for those European countries in which the firms were active (Hvidt 1971).

Table 6—Effect of Other Immigrant Groups

| | ln(*cows*) (1) | ln(*cows*) (2) | ln(*cows*) (3) | ln(*cows*) (4) | ln(*cows*) (5) | ln(*cows*) (6) | ln(*cows*) (7) |
|---|---|---|---|---|---|---|---|
| $post1880 = 1 \times \ln(Danes1880)$ | 0.009 (0.002) | | 0.009 (0.002) | 0.007 (0.002) | 0.004 (0.002) | 0.039 (0.015) | 0.065 (0.015) |
| $post1880 = 1 \times \ln(foreign1880)$ | | 0.007 (0.007) | −0.009 (0.007) | −0.013 (0.007) | −0.025 (0.009) | −0.013 (0.007) | −0.011 (0.006) |
| $post1880 = 1 \times \ln(Scandinavian1880)$ | | | | 0.005 (0.002) | | | |
| $post1880 = 1 \times \ln(Swedish1880)$ | | | | | 0.003 (0.002) | 0.001 (0.002) | |
| $post1880 = 1 \times \ln(Norwegian1880)$ | | | | | 0.013 (0.002) | 0.004 (0.004) | |
| $Danes\_present = 1 \times post1880 = 1 \times \ln(Swedish1880)$ | | | | | | 0.005 (0.004) | |
| $Danes\_present = 1 \times post1880 = 1 \times \ln(Norwegian1880)$ | | | | | | 0.011 (0.004) | |
| $Danes\_present = 1 \times post1880 = 1 \times \ln(foreign1880)$ | | | | | | −0.067 (0.017) | −0.030 (0.015) |
| Year FE | Y | Y | Y | Y | Y | Y | Y |
| County FE | Y | Y | Y | Y | Y | Y | Y |
| Region × year FE | Y | Y | Y | Y | Y | Y | Y |
| Geography × year FE | Y | Y | Y | Y | Y | Y | Y |
| Observations | 12,954 | 12,954 | 12,954 | 12,954 | 12,954 | 12,954 | 12,954 |
| Number of counties | 2,159 | 2,159 | 2,159 | 2,159 | 2,159 | 2,159 | 2,159 |

*Notes:* Geography controls include the natural logarithm of the share of county area with high or very high pasture suitability, the share of county area with high or very high wheat suitability, average elevation, average Terrain Ruggedness Index of county area (measured in millimeters), and the distance to a canal or steamboat-navigable river. Robust standard errors in parentheses, clustered at the county level.

## IV. Conclusion

We have provided a wealth of evidence that Danish settlements established before 1880 significantly fostered the development of the dairy sector in the United States: areas that had received more Danes both specialized in dairying and employed more modern production techniques. Moreover, we provide suggestive evidence that this was principally due to knowledge transfer to the local population rather than a direct effect of Danes working in dairying themselves. We have thus presented an example of knowledge transfer through migration in a rather unique setting: first, the story of Danes bringing in technological knowledge is based on an *existing* immigrant community. Second, these original immigrants were by no means “economically desirable,” and third, we were able to show how even a very small group of immigrants can have a positive impact on the local economy through spillover effects. This has some relevance for the current debate on immigration, especially as it has often taken a rather negative stance recently. Our results show that it is difficult to determine which immigrants are “desirable” ex ante and that the host country may benefit from immigration even decades after the first arrival.

# Appendix A

Table A1—Summary Statistics

| | Obs. | Mean | SD | Min. | Max. | 25% | 75% | 90% | 95% | 99% |
|---|---|---|---|---|---|---|---|---|---|---|
| 1870–1880 | | | | | | | | | | |
| *Danes* | 2,159 | 27 | 126 | 0 | 3,095 | 0 | 10 | 51 | 103 | 537 |
| *cows* | 4,318 | 4,892 | 6,092 | 1 | 93,369 | 1,739 | 5,864 | 10,077 | 14,214 | 31,558 |
| *industrial dairy* | 2,159 | 3 | 17 | 0 | 251 | 0 | 0 | 3 | 12 | 82 |
| *wheat* | 4,318 | 170,140 | 302,542 | 0 | 4.297,840 | 6,102 | 196,060 | 521,039 | 742,123 | 1.456,544 |
| *pigs* | 4,318 | 16,740 | 17,243 | 0 | 152,975 | 5,471 | 22,273 | 36,659 | 50,155 | 86,250 |
| *sheep* | 4,318 | 14,146 | 29,625 | 0 | 461,120 | 2,240 | 12,835 | 31,346 | 59,138 | 149,117 |
| *cattle* | 4,318 | 8,346 | 8,811 | 0 | 177,270 | 3,265 | 10,623 | 17,427 | 23,623 | 40,764 |
| *total population* | 4,318 | 20,143 | 38,889 | 5 | 942,292 | 7,138 | 22,258 | 35,866 | 49,541 | 143,839 |
| *Swedes* | 2,159 | 84 | 452 | 0 | 15,344 | 0 | 25 | 145 | 369 | 1,615 |
| *Norwegians* | 2,159 | 75 | 424 | 0 | 10,422 | 0 | 6 | 56 | 319 | 1,669 |
| *total butter* (in pounds) | 46 | 17,500 | 24,900 | 45 | 120,878 | 1,404 | 19,245 | 60,209 | 69,723 | 1.208,782 |
| *ind. butter* (in pounds) | 46 | 638 | 1,843 | 0 | 8,956 | 0 | 144 | 2,074 | 6,183 | 8,956 |
| *farmbutter* (in pounds) | 46 | 16,900 | 23,500 | 45 | 111,922 | 1,356 | 19,161 | 53,658 | 67,634 | 111,922 |
| Post-1880 | | | | | | | | | | |
| *Danes* | 8,636 | 62 | 325 | 0 | 12,090 | 0 | 22 | 117 | 259 | 1,098 |
| *cows* | 8,636 | 8,367 | 8,614 | 8 | 119,423 | 3,229 | 10,391 | 16,585 | 23,556 | 44,454 |
| *industrial dairy* | 6,477 | 9 | 25 | 0 | 489 | 0 | 6 | 23 | 42 | 130 |
| *wheat* | 8,636 | 219,501 | 650,904 | 0 | 31.377,274 | 3,028 | 236,749 | 621,876 | 966,749 | 1.852,127 |
| *pigs* | 8,636 | 25,632 | 26,060 | 4 | 252,139 | 8,414 | 32,081 | 59,095 | 81,826 | 122,102 |
| *sheep* | 8,629 | 16,307 | 49,443 | 0 | 1.402,036 | 1,670 | 13,445 | 32,550 | 59,794 | 196,005 |
| *cattle* | 8,636 | 13,658 | 16,863 | 0 | 410,409 | 4,265 | 16,764 | 30,837 | 41,564 | 75,510 |
| *total population* | 8,636 | 36,333 | 96,065 | 243 | 3.053,017 | 13,542 | 31,710 | 56,356 | 88,422 | 344,177 |
| *Swedes* | 8,636 | 231 | 1,593 | 0 | 68,736 | 1 | 58 | 373 | 925 | 3,855 |
| *Norwegians* | 8,636 | 120 | 755 | 0 | 25,891 | 0 | 14 | 156 | 510 | 2,270 |
| *total butter* (in pounds) | 184 | 31,700 | 34,800 | 86 | 166,500 | 5,292 | 49,319 | 82,675 | 111,395 | 139,023 |
| *ind. butter* (in pounds) | 184 | 11,600 | 22,900 | 0 | 146,295 | 61 | 12,305 | 37,283 | 61,140 | 103,885 |
| *farmbutter* (in pounds) | 184 | 20,000 | 20,200 | 86 | 98,241 | 3,520 | 29,511 | 48,478 | 61,789 | 79,551 |
| Constant variables | | | | | | | | | | |
| *foreign1880* | 2,159 | 2,967 | 13,882 | 0 | 290,641 | 61 | 2,277 | 5,779 | 9,187 | 46,719 |
| *pasture suitability* | 2,159 | 0.76 | 0.37 | 0 | 1 | 0.62 | 1 | 1 | 1 | 1 |
| *wheat suitability* | 2,159 | 0.29 | 0.39 | 0 | 1 | 0 | 0.59 | 1 | 1 | 1 |
| *average ruggedness* | 2,159 | 0.58 | 0.69 | 0 | 5 | 0.17 | 0.68 | 1.54 | 2.15 | 3.10 |
| *average elevation* | 2,159 | 289 | 307 | 1 | 2,408 | 123 | 337 | 492 | 749 | 1,825 |
| *distance river* | 2,159 | 58,566 | 80,908 | 2 | 774,147 | 13,792 | 68,630 | 143,521 | 200,404 | 441,126 |
| *area* (in square miles) | 2,159 | 630 | 1,298 | 15 | 18,623 | 283 | 566 | 789 | 1,313 | 6,764 |
| *wildfrontier* | 2,159 | 0.14 | 0.35 | 0 | 1 | 0 | 0 | 1 | 1 | 1 |

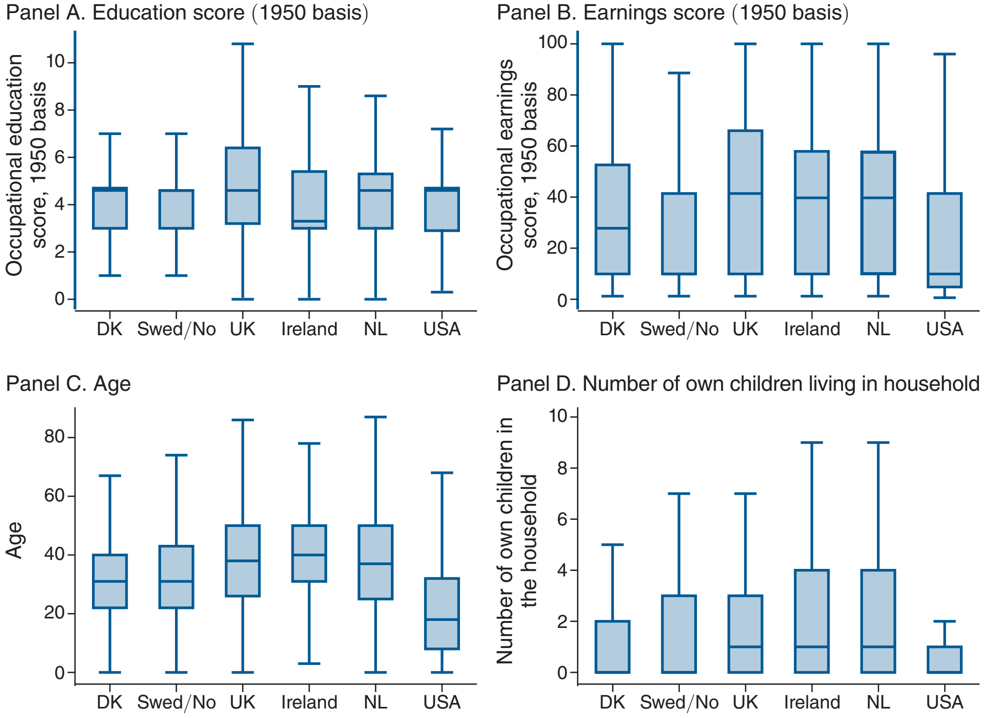


Figure A1. Comparison of Danes to Other Nationalities, 1880

*Note:* Excludes outside values.

*Source:* IPUMS, 1880 census

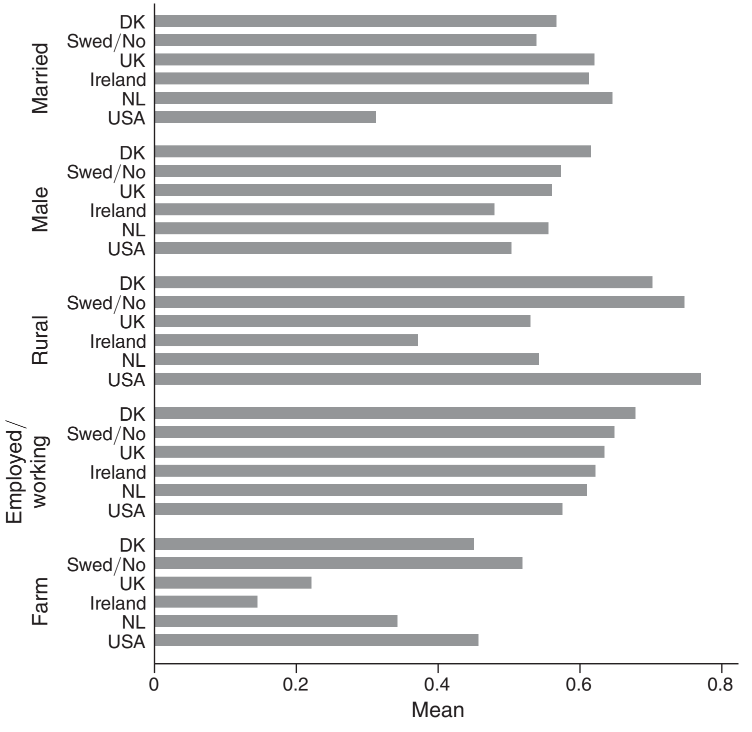


Figure A2. Comparison of Danes to Other Nationalities, 1880

*Source:* IPUMS, 1880 census

Table A2—Correlations of the Distribution of Danes in 1880 with Geographic Factors

| | ln(*Danes*1880) all (1) | ln(*Danes*1880) *Danes*1880 $>$ 3 (2) |
|---|---|---|
| ln(*PastureSuitability*) | −0.091 | −0.024 |
| | (0.036) | (0.008) |
| ln(*WheatSuitability*) | 0.145 | 0.015 |
| | (0.028) | (0.006) |
| ln(*Ruggedness*) | −0.782 | −0.124 |
| | (0.361) | (0.089) |
| ln(*Elevation*) | −0.298 | −0.172 |
| | (0.368) | (0.099) |
| ln(*DistanceRiver*) | −0.021 | 0.014 |
| | (0.155) | (0.041) |
| *US Census Region Middle Atlantic* | 2.363 | −0.052 |
| | (1.320) | (0.254) |
| *US Census Region East North Central* | −1.537 | 0.019 |
| | (1.393) | (0.272) |
| *US Census Region West North Central* | 1.550 | 0.209 |
| | (1.402) | (0.280) |
| *US Census Region South Atlantic* | −11.150 | −1.334 |
| | (1.209) | (0.254) |
| *US Census Region East South Central* | −9.912 | −0.988 |
| | (1.249) | (0.252) |
| *US Census Region West South Central* | −4.573 | −1.207 |
| | (1.321) | (0.243) |
| *US Census Region Mountain* | 5.046 | 0.998 |
| | (1.619) | (0.386) |
| *US Census Region Pacific* | 5.606 | 0.180 |
| | (1.263) | (0.250) |
| *Constant* | −0.131 | 3.814 |
| | (2.306) | (0.522) |
| Observations | 2,159 | 792 |

*Note:* Robust standard errors in parentheses.

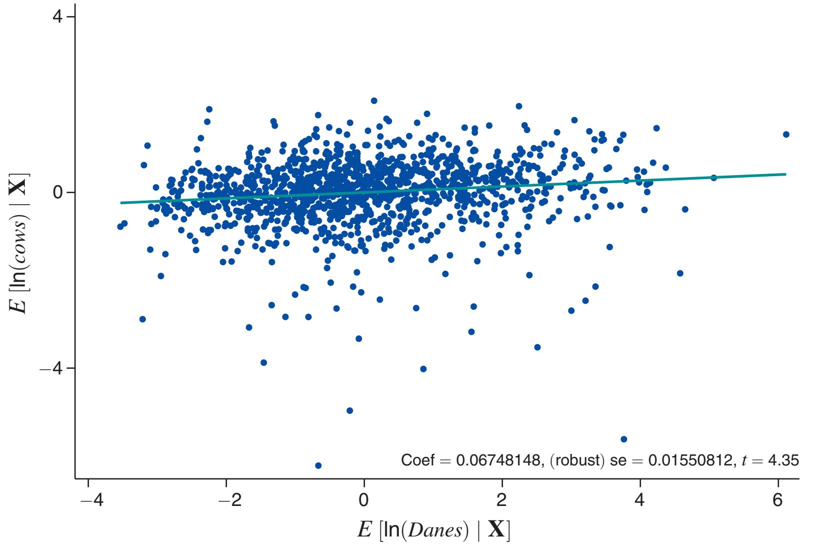


Figure A3. Partial Regression Plot between ln(*Danes*) and ln(*cows*). County Level, Years 1890-1920

Table A3—Difference-in-Difference Estimation for Butter Production (State Level)

| | ln(*totalbutter*) (1) | ln(*ind.butter*) (2) | ln(*farmbutter*) (3) |
|---|---|---|---|
| $post1880 = 1 \times \ln(Danes1880)$ | −0.083 | 0.869 | −0.187 |
| | (0.055) | (0.800) | (0.046) |
| Time FE | Y | Y | Y |
| State FE | Y | Y | Y |
| Region × year FE | Y | Y | Y |
| Geography × year FE | Y | Y | Y |
| Observations | 210 | 210 | 210 |
| Number of states | 42 | 42 | 42 |

*Notes:* Geography controls include the natural logarithm of the share of state area with high or very high pasture suitability, the share of state area with high or very high wheat suitability, average elevation, average Terrain Ruggedness Index of state area (measured in millimeters), and the distance to a canal or steamboat-navigable river. Robust standard errors in parentheses, clustered at the state level.

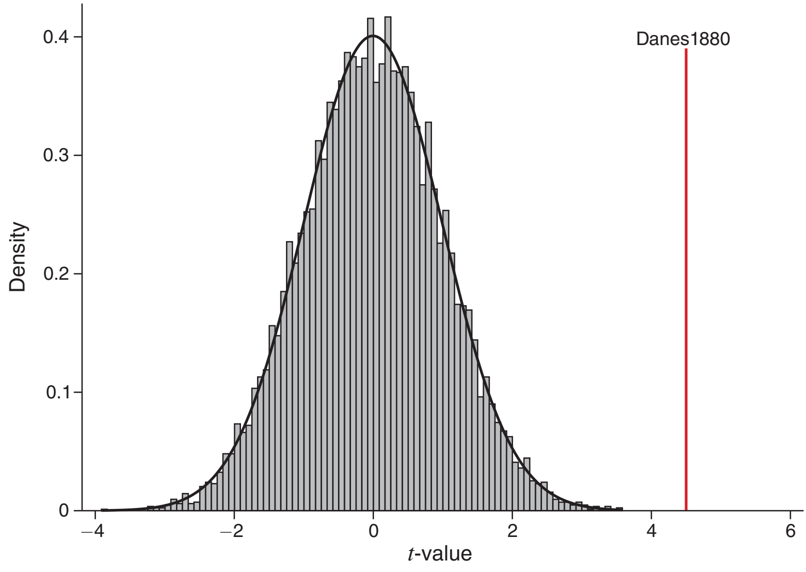


FIGURE A4. HISTOGRAM OF $t$-VALUES RESULTING FROM RANDOMIZING THE DISTRIBUTION OF DANES IN EQUATION (1)

TABLE A4—CONLEY STANDARD ERRORS FOR DIFFERENT CUTOFF POINTS

| | ln(*cows*) 50 km (1) | ln(*cows*) 100 km (2) | ln(*cows*) 200 km (3) | ln(*cows*) 500 km (4) |
|---|---|---|---|---|
| $post1880 = 1 \times \ln(Danes1880)$ | 0.0085 | 0.0085 | 0.0085 | 0.0085 |
| | (0.0011) | (0.0013) | (0.0015) | (0.0017) |
| Year FE | Y | Y | Y | Y |
| County FE | Y | Y | Y | Y |
| Region × year FE | Y | Y | Y | Y |
| Geography × year FE | Y | Y | Y | Y |
| Observations | 12,954 | 12,954 | 12,954 | 12,954 |

*Notes:* Geography controls include the natural logarithm of the share of county area with high or very high suitability, the share of county area with high or very high wheat suitability, average elevation, average Terrain Ruggedness Index of county area (measured in millimeters), and the distance to a canal or steamboat-navigable river.

Table A5—Further Robustness Checks, Other Outcome Variables

| | ln(*wheat*) (1) | ln(*sheep*) (2) | ln(*pigs*) (3) | ln(*cattle*) (4) | Dairy cows/ nondairy cattle (5) | ln(*landvalue*) by acre (6) |
|---|---|---|---|---|---|---|
| $post1880 = 1 \times \ln(Danes1880)$ | 0.009 | 0.006 | 0.008 | 0.004 | 0.025 | 0.001 |
| | (0.011) | (0.006) | (0.003) | (0.002) | (0.007) | (0.001) |
| Year FE | Y | Y | Y | Y | Y | Y |
| County FE | Y | Y | Y | Y | Y | Y |
| Region × year FE | Y | Y | Y | Y | Y | Y |
| Geography × year FE | Y | Y | Y | Y | Y | Y |
| Observations | 12,954 | 12,947 | 12,954 | 12,947 | 12,947 | 12,954 |
| Number of counties | 2,159 | 2,159 | 2,159 | 2,159 | 2,159 | 2,159 |

*Notes:* Geography controls include the natural logarithm of the share of county area with high or very high pasture suitability, the share of county area with high or very high wheat suitability, average elevation, average Terrain Ruggedness Index of county area (measured in millimeters), and the distance to a canal or steamboat-navigable river. Robust standard errors in parentheses, clustered at the county level.

Table A6—Further Robustness Checks, Additional Controls

| | ln(*cows*) Midwest (1) | ln(*cows*) Frontier (2) | ln(*cows*) Mormon (3) | ln(*cows*) initial pop. (4) | ln(*cows*) MA 1870 (5) | ln(*cows*) res. region FE (6) | ln(*cows*) geography (7) |
|---|---|---|---|---|---|---|---|
| $post1880 = 1 \times \ln(Danes1880)$ | 0.007 | 0.009 | 0.009 | 0.016 | 0.009 | 0.006 | 0.007 |
| | (0.004) | (0.002) | (0.002) | (0.001) | (0.002) | (0.001) | (0.001) |
| Year FE | Y | Y | Y | Y | Y | Y | Y |
| County FE | Y | Y | Y | Y | Y | Y | Y |
| Region × year FE | Y | Y | Y | Y | Y | N | Y |
| Geography × year FE | Y | Y | Y | Y | Y | N | Y |
| Frontier × year FE | N | Y | N | N | N | N | N |
| Mormon × year FE | N | N | Y | N | N | N | N |
| ln(pop1870) × year FE | N | N | N | Y | N | N | N |
| Market access × year FE | N | N | N | N | Y | N | Y |
| Res. region × year FE | N | N | N | N | N | Y | Y |
| Observations | 4,596 | 12,954 | 12,954 | 12,954 | 12,942 | 12,942 | 12,942 |
| Number of counties | 766 | 2,159 | 2,159 | 2,159 | 2,157 | 2,157 | 2,157 |

*Notes:* Geography controls include the natural logarithm of the share of county area with high or very high pasture suitability, the share of county area with high or very high wheat suitability, average elevation, average Terrain Ruggedness Index of county area (measured in millimeters), and the distance to a canal or steamboat-navigable river. Robust standard errors in parentheses, clustered at the county level.

## Appendix B

In the spirit of Rambachan and Roth (2023), we consider here the structure and the mechanisms underlying the pre-trend. As noted previously, we thus repeat the flexible estimation but condition on different numbers of Danes, i.e., we include only counties with a positive number of Danes in 1880, with more than one Dane in 1880, more than two Danes, etc. The estimates for the effect in 1870 (i.e., the pre-trend) are shown in Figure B1. When focusing on the intensive margin of Danish treatment, i.e., conditioning on a "significant" number of Danes (here two or above), the pre-trend becomes increasingly insignificant, and the magnitude of the coefficient falls. Thus, the negative coefficient in 1870 when estimating on all counties seems to be due to the inclusion of counties that had no Danes (or just one Dane) in 1880. The

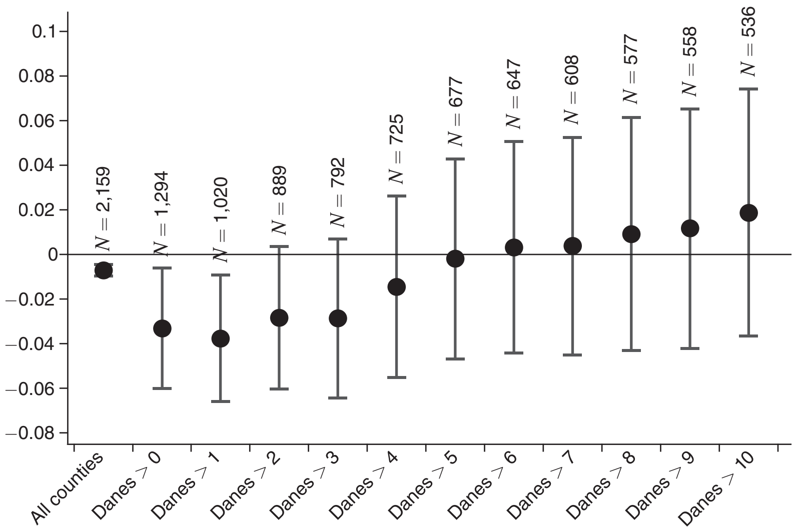


Figure B1. Coefficients on Interaction between Year 1870 and ln(*Danes*1880) for Different Subsamples (Based on the Number of Danes in 1880), Dependent Variable: ln(*cows*)

largest streams of migration occurred first after 1890, and thus these places were underdeveloped in all respects; they received no Danes but also had no significant agriculture in 1870. With migration picking up, these counties converged with those counties where settlement occurred earlier.

Column 3 in Table B1 shows the flexible difference-in-differences specification for ln(*farmbutter*) as the outcome variable. The number of Danes in the county is unrelated to butter production before 1880. This can also be seen as further evidence that the effect we are finding is not just due to Danes settling in areas where dairying was already strong or that were particularly suited for dairying. This notion is supported by the fact that we also do not find a significant relation between Danes in 1880 and dairy cows in 1850, using data from the agricultural census in 1850 (and 1860), which report both the number of dairy cows and the butter produced on farms. Whereas the number of cows should be quite reliable, the amount of butter may not be representative. As noted in the 1900 census, many farms produced butter only for personal consumption and this was not counted, with this issue likely to be more severe for earlier years. Nevertheless, the dairy cows would be counted. If we run the same regressions using the 1850 data, we find a positive relation of Danes in 1880 with farm butter in 1850 but no significant relation of Danes in 1880 for the more reliable dairy cows measure.[55] Thus, for this smaller sample of counties (because some of the main destination states for Danes were first formed after 1850), there is also no evidence of a pre-trend.[56] For our main results, we focus on

[55] Results are available upon request.

[56] Our main results also still hold in the smaller sample, which we can trace back to 1850. The results for the number of dairy cows are unchanged; the results on industrial dairying and butter produced on farms lose power due to the loss of important Danish settlement areas. Results are available upon request.

Table B1—Flexible Difference-in-Difference Estimation

| | ln(*cows*) all (1) | ln(*cows*) *Danes*1880 > 2 (2) | ln(*farmbutter*) all (3) |
|---|---|---|---|
| *year*_1 = 1870 × ln(*Danes*1880) | −0.007 | −0.026 | −0.005 |
| | (0.002) | (0.018) | (0.003) |
| *year*_1 = 1890 × ln(*Danes*1880) | 0.004 | 0.030 | −0.002 |
| | (0.001) | (0.010) | (0.002) |
| *year*_1 = 1900 × ln(*Danes*1880) | 0.005 | 0.031 | −0.005 |
| | (0.001) | (0.018) | (0.002) |
| *year*_1 = 1910 × ln(*Danes*1880) | 0.005 | 0.051 | −0.01 |
| | (0.002) | (0.018) | (0.003) |
| *year*_1 = 1920 × ln(*Danes*1880) | 0.004 | 0.054 | −0.013 |
| | (0.002) | (0.023) | (0.003) |
| *year*_1 = 1950 × ln(*Danes*1880) | 0.002 | 0.026 | |
| | (0.002) | (0.024) | |
| *year*_1 = 1960 × ln(*Danes*1880) | 0.005 | 0.049 | |
| | (0.003) | (0.029) | |
| *year*_1 = 1970 × ln(*Danes*1880) | 0.007 | 0.072 | |
| | (0.004) | (0.037) | |
| Year FE | Y | Y | Y |
| County FE | Y | Y | Y |
| Region × year FE | Y | Y | Y |
| Geography × year FE | Y | Y | Y |
| Observations | 18,900 | 7,812 | 12,815 |
| Number of counties | 2,100 | 868 | 2,159 |

*Notes:* Geography controls include the natural logarithm of the share of county area with high or very high pasture suitability, the share of county area with high or very high wheat suitability, average elevation, average Terrain Ruggedness Index of county area (measured in millimeters), and the distance to a canal or steamboat-navigable river. Robust standard errors in parentheses, clustered at the county level.

all counties and from 1870, as we would like to capture the effect of comparing counties with no or very few Danes with those receiving more significant numbers of Danes.[57]

Tables B2 and B3 provide further information on the pre-trend. Table B2 shows correlations for the number of Danes in 1880 and the amount of butter produced on farms in 1860 and 1870 in columns 1 and 2 and with the change in the amount of butter produced on farms in column 3. Both the correlation in 1870 and the correlation with the change are positive and significant. Despite the fact that the early figures on butter may be unreliable, this may be concerning if we imagine that Danes might have settled in areas that were already on a divergent path with respect to dairy production. Table B3, however, shows that this same pre-trend exists also for all other variables related to agricultural output. We therefore interpret this as simply due to the general settlement pattern of these areas, which had only just begun during these early decades.

[57] Also, most of our data, apart from the number of Danes and the number of dairy cows, start first after 1890, exactly due to the fact that this is when migration picked up. This is also the reason why we choose the difference-in-differences framework, although it relies on the common trend assumption, as the shift-share approach, for example, would assign zero Danes to counties having no Danes in 1880 in all subsequent years.

Table B2—Correlations of Number of Danes in 1880 with Measures of Farm Butter in 1860 and 1870, OLS

| | ln(*farmbutter*) 1860 (1) | ln(*farmbutter*) 1870 (2) | D.ln(*farmbutter*) (3) |
|---|---|---|---|
| ln(*Danes*1880) | 0.005 | 0.018 | 0.013 |
| | (0.004) | (0.004) | (0.003) |
| Region FE | Y | Y | Y |
| Geography | Y | Y | Y |
| Number of counties | 1,774 | 1,774 | 1,774 |
| $R^2$ | 0.440 | 0.526 | 0.273 |

*Notes:* Geography controls include the natural logarithm of the share of county area with high or very high pasture suitability, the share of county area with high or very high wheat suitability, average elevation, average Terrain Ruggedness Index of county area (measured in millimeters), and the distance to a canal or steamboat-navigable river. Robust standard errors in parentheses.

Table B3—Correlations of Number of Danes in 1880 with Agricultural Produce in 1860 and 1870, OLS

| | D.ln(*wheat*) (1) | D.ln(*pigs*) (2) | D.ln(*cattle*) (3) | D.ln(*sheep*) (4) |
|---|---|---|---|---|
| ln(*Danes*1880) | 0.038 | 0.015 | 0.008 | 0.036 |
| | (0.015) | (0.005) | (0.002) | (0.006) |
| Region FE | Y | Y | Y | Y |
| Geography | Y | Y | Y | Y |
| Number of counties | 1,774 | 1,774 | 1,773 | 1,774 |
| $R^2$ | 0.154 | 0.112 | 0.318 | 0.168 |

*Notes:* Geography controls include the natural logarithm of the share of county area with high or very high pasture suitability, the share of county area with high or very high wheat suitability, average elevation, average Terrain Ruggedness Index of county area (measured in millimeters), and the distance to a canal or steamboat-navigable river. Robust standard errors in parentheses.

## REFERENCES


**Abramitzky, Ran, and Leah P. Boustan.** 2017. "Immigration in American Economic History." *Journal of Economic Literature* 55 (4): 1311–45.

**Abramitzky, Ran, Leah P. Boustan, and Katherine Eriksson.** 2012. "Europe's Tired, Poor, Huddled Masses: Self-Selection and Economic Outcomes in the Age of Mass Migration." *American Economic Review* 102 (5): 1832–56.

**Akcigit, Ufuk, John Grigsby, and Tom Nicholas.** 2017a. "Immigration and the Rise of American Ingenuity." *American Economic Review: Papers and Proceedings* 107 (5): 327–31.

**Akcigit, Ufuk, John Grigsby, and Tom Nicholas.** 2017b. "The Rise of American Ingenuity: Innovation and Inventors of the Golden Age." NBER Working Paper 23047.

**Alvord, Henry E.** 1900. "Dairy Development in the United States." In *Yearbook of the United States Department of Agriculture for 1899*, 381–402.

**Ammon, Christina, and Anna Baiardi.** 2023. "The Long-Run Effect of Migration on Firms' Trade: Evidence from China." Unpublished.

**Andersen, Thomas Barnebeck, Peter Sandholt Jensen, and Christian Volmar Skovsgaard.** 2016. "The Heavy Plow and the Agricultural Revolution in Medieval Europe." *Journal of Development Economics* 118: 133–49.

**Arthur, W. Brian.** 1990. "'Silicon Valley' Locational Clusters: When Do Increasing Returns Imply Monopoly?" *Mathematical Social Sciences* 19 (3): 235–51.

**Atack, Jeremy.** 2015. "Historical Geographic Information Systems (GIS) Database of Steamboat-Navigated Rivers During the Nineteenth Century in the United States." Historical Transportation Files. https://my.vanderbilt.edu/jeremyatack/data-downloads/.

**Atack, Jeremy.** 2017. "Historical Geographic Information Systems (GIS) Database of Nineteenth Century U.S. Canals." Historical Transportation Files. https://my.vanderbilt.edu/jeremyatack/data-downloads/.

**Bahar, Dany, Prithwiraj Choudhury, and Hillel Rapoport.** 2018. "Migration and Innovation: Evidence from Technology Take-offs." Unpublished.

**Bahar, Dany, and Hillel Rapoport.** 2018. "Migration, Knowledge Diffusion and the Comparative Advantage of Nations." *Economic Journal* 128 (612): F273–F305.

**Bateman, Fred** 1968. "Improvement in American Dairy Farming, 1850–1910: A Quantitative Analysis." *Journal of Economic History* 28 (2): 255–73.

**Boberg-Fazlic, Nina, Paul Sharp, Peter Jensen, Markus Lampe, and Christian Volmar Skovsgaard.** 2023. "Getting to Denmark: The Role of Elites for Development." *Journal of Economic Growth*.

**Boberg-Fazlic, Nina, and Paul Sharp.** 2024. "Replication Data for: Immigrant Communities and Knowledge Spillovers: Danish Americans and the Development of the Dairy Industry in the United States." American Economic Association [publisher], Inter-university Consortium for Political and Social Research [distributor]. https://doi.org/10.3886/E180221V1.

**Borjas, George J., and Kirk B. Doran.** 2012. "The Collapse of the Soviet Union and the Productivity of American Mathematicians." *Quarterly Journal of Economics* 127 (3): 1143–203.

**Brøndal, Jørn.** 2013. "Danes and Danish Americans, 1870-1940." In *Immigrants in American History: Arrival, Adaptation, and Integration*, edited by Elliott Robert Barkan, 323–31. Santa Barbara, CA: ABC-CLIO.

**Buchardi, Konrad B., Thomas Chaney, and Tarek A. Hassan.** 2019. "Migrants, Ancestors, and Foreign Investments." *Review of Economic Studies* 86 (4): 1448–86.

**Buchardi, Konrad B., and Tarek A. Hassan.** 2013. "The Economic Impact of Social Ties: Evidence from German Reunification." *Quarterly Journal of Economics* 128 (3): 1219–71.

**Bustos, Paula, Bruna Caprettini, and Jocopo Ponticelli.** 2016. "Agricultural Productivity and Structural Transformation: Evidence from Brazil." *American Economic Review* 106 (6): 1320–65.

**Cance, Alexander E.** 1925. "Immigrants and American Agriculture." *Journal of Farm Economics* 7 (1): 102–14.

**Chen, Shuo, and James Kai-sing Kung.** 2016. "Of Maize and Men? The Effect of a New World Crop on Population and Economic Growth in China." *Journal of Economic Growth* 21 (1): 71–99.

**Christensen, Thomas P.** 1924. "The History of Danes in Iowa." Unpublished.

**Christensen, Thomas P.** 1927. "Danish Settlement in Minnesota." *Minneosta History* 8 (4): 363–85.

**Christensen, Thomas P.** 1928. "Danish Settlement in Wisconsin." *Wisconsin Magazine of History* 12 (1): 19–40.

**Christensen, Thomas P.** 1957. "The First Cream Separator in the United States." *Annals of Iowa* 34 (1): 56–58.

**Comin, Diego, William Easterly, and Erick Gong.** 2010. "Was the Wealth of Nations Determined in 1000 B.C.?" *American Economic Journal: Macroeconomics* 2 (3): 65–97.

**Conley, Timothy G., and Christopher R. Udry.** 2010. "Learning about a New Technology: Pineapple in Ghana." *American Economic Review* 100 (1): 35–69.

**Cook, Justin C.** 2014a. "Potatoes, Milk, and the Old World Population Boom." *Journal of Development Economics* 110: 123–38.

**Cook, Justin C.** 2014b. "The Role of Lactase Persistency in Precolonial Development." *Journal of Economic Growth* 19 (4): 369–406.

**Dall, Torben, Peter S. Jensen, and Amber Naz.** 2014. "New Crops, Local Soils and Urbanization: Clover, Potatoes and the Growth of Danish Market Towns, 1672-1901." EHES Working Papers in Economic History 65.

**Danker, Marshall P.** 1968. "Factors Influencing the Use of Agricultural Cooperatives." *Illinois Agricultural Economics* 8 (1): 20–26.

**Det Danske Udvandrerarkiv.** 2018. "Københavns Politis Udvandrerprotokoller." Danish Demographic Database 12-02-2018.

**Docquier, Frédéric Docquier, Riccardo Turati, Jérôme Valette, and Chrysovalantis Vasilakis.** 2020. "Birthplace Diversity and Economic Growth: Evidence from the US in the Post-World War II Period." *Journal of Economic Geography* 20 (2): 321–54.

**Donaldson, Dave, and Richard Hornbeck.** 2016. "Railroads and American Economic Growth: A 'Market Access' Approach." *Quarterly Journal of Economics* 131 (2): 799–858.

**Drejer, A. Axelsen.** 1933. "Mejeribruget." In *Det Danske Landbrugs Historie*, edited by Kristian Hansen, 99–419. Copenhagen: G. E. C. Gads.

**Edwards, Everett E.** 1938. "T. L. Haecker, the Father of Dairying in Minnesota." *Minnesota History* 19 (2): 148–61.

**Fetzer, Thiemo.** 2014. "Can Workfare Programs Moderate Violence? Evidence from India." Suntory and Toyota International Centres for Economics and Related Disciplines Working Paper 53.

**Fourie, Johan, and Dieter von Fintel.** 2014. "Settler Skills and Colonial Development: The Huguenot Wine-Makers in Eighteenth-Century Dutch South Africa." *Economic History Review* 67 (4): 932–63.

**Frost, Warwick.** 2002. "Migrants and Technological Transfer: Chinese Farming in Australia, 1850-1920." *Australian Economic History Review* 42 (2): 113–31.

**Furer, Howard B.** 1972. *The Scandinavians in America, 986-1970*. Dobbs Ferry, NY: Oceana Publications, Inc.

**Galor, Oded, and David N. Weil.** 2000. "Population, Technology, and Growth: From Malthusian Stagnation to the Demographic Transition and Beyond." A*merican Economic Review* 90 (4): 806–28.

**Gould, David M.** 1994. "Immigrant Links to the Home Country: Empirical Implications for U.S. Bilateral Trade Flows." *Review of Economics and Statistics* 76 (2): 302–16.

**Greif, Avner.** 1989. "Reputation and Coalitions in Medieval Trade: Evidence on the Maghribi Traders." *Journal of Economic History* 49 (4): 857–82.

**Greif, Avner** 1993. "Contract Enforceability and Economic Institutions in Early Trade: The Maghribi Traders' Coalition." *American Economic Review* 83 (3): 525–48.

**Haines, Michael R.** 2010. "Historical, Demographic, Economic, and Social Data: The United States, 1790-2002." Inter-University Consortium for Political and Social Research. https://doi.org/10.3886/ICPSR02896.v3 (accessed May 21, 2010).

**Haines, Michael R., Price Fishback, and Paul Rhode.** 2018. "United States Agriculture Data, 1840-2012." Inter-University Consortium for Political and Social Research https://doi.org/10.3886/ICPSR35206.v4 (accessed August 20, 2018).

**Hatton, Timothy J.** 2010. "The Cliometrics of International Migration: A Survey." *Journal of Economic Surveys* 24 (5): 941–69.

**Henriksen, Ingrid.** 1993. "The Transformation of Danish Agriculture 1870–1914." In *The Economic Development of Denmark and Norway since 1870*, edited by K. G. Persson, 153–77. Aldershot, UK: Edward Elgar.

**Henriksen, Ingrid, Markus Lampe, and Paul Sharp.** 2012. "The Strange Birth of Liberal Denmark: Danish Trade Protection and the Growth of the Dairy Industry Since the Mid-Nineteenth Century." *Economic History Review* 65 (2): 770–88.

**Henriksen, Ingrid, and Kevin H. O'Rourke.** 2005. "Incentives, Technology and the Shift to Year-Round Dairying in Late Nineteenth-Century Denmark." *Economic History Review* 58 (3): 520–45.

**Hornbeck, Richard** 2010. "Barbed Wire: Property Rights and Agricultural Development." *Quarterly Journal of Economics* 125 (2): 767–810.

**Hornung, Erik.** 2014. "Immigration and the Diffusion of Technology: The Huguenot Diaspora in Prussia." *American Economic Review* 104 (1): 84–122.

**Howitt, Peter.** 2000. "Endogenous Growth and Cross-Country Income Differences." *American Economic Review* 90 (4): 829–46.

**Hsiang, Solomon M.** 2010. "Temperatures and Cyclones Strongly Associated with Economic Production in the Caribbean and Central America." *PNAS* 107 (35): 15367–72.

**Hunt, Jennifer, and Marjolaine Gauthier-Loiselle.** 2010. "How Much Does Immigration Boost Innovation?" *American Economic Journal: Macroeconomics* 2 (2): 31–56.

**Hvidt, Kristian** 1971. "Flugten til Amerika eller Drivkræfter I masseudvandringen fra Danmark 1868-1914." Unpublished.

**Jensen, B.** 1897. "Oversight over Sharon Creamery's 2." *Mælketiderne* 10: 551–52.

**Jeppesen, Torben Grøngaard.** 2016. Fra Skandinavisk Immigrant til Amerikaner: Teori og Empiri om Assimileringen i det Amerikanske Samfund. *University of Southern Denmark Studies in History and Social Sciences* 537.

**Jia, Ruixue.** 2014. "Weather Shocks, Sweet Potatoes and Peasant Revolts in Historical China." *Economic Journal* 124 (575): 92–118.

**Jørgensen, Steffen E.** 1993. "A Scattered People? Danish Settlement Structure and Community Transplantations in the Midwest. With Examples from the Danish Islands of Lolland, Falster and Møn." In *On Distant Shores: Proceeding of the Marcus Lee Hansen Immigration Conference*, edited by

Birgit F. Larsen, Henning Bender and Karen Veien, 99–120. Aalborg, Denmark: Danes Worldwide Archives.

**Kantor, Shawn, and Alexander Whalley.** 2019. "Research Proximity and Productivity: Long-Term Evidence from Agriculture." *Journal of Political Economy* 127 (2): 819–54.

**Karreman, Bas, Martijn J. Burger, and Frank G. van Oort.** 2017. "Location Choices of Chinese Multinationals in Europe: The Role of Overseas Communities." *Economic Geography* 93 (2): 131–61.

**Keillor, Steven J.** 1993. "Agricultural Change and Crosscultural Exchange: Danes, Americans, and Dairying, 1880-1930." *Agricultural History* 67 (4): 58–79.

**Keillor, Steven J.** 2000. *Cooperative Commonwealth: Co-ops in Rural Minnesota, 1859-1939*. St. Paul, MN: Historical Society Press.

**Kerr, Sari Pekkala, and William R. Kerr.** 2011. "Economic Impacts of Immigration: A Survey." *Finnish Economic Papers* 24 (1): 1–32.

**Kerr, William R., and William F. Lincoln.** 2010. "The Supply Side of Innovation: H-1B Visa Reforms and U.S. Ethnic Invention." *Journal of Labor Economics* 28 (3): 473–508.

**Kjær, Iver, and M. Baumann Larsen.** 1972. "Dansk i Amerika: Status og Perspektiv." *Sprog i Norden* 3 (1): 45–57.

**Knapp, Joseph G.** 1969. *The Rise of American Cooperative Enterprise: 1620-1920.* Dansville, IL: Interstate Publishers and Printers, Inc.

**Korchmina, Elena, and Paul Sharp.** 1920. "Denmark and Russia: What Can we Learn from the Historical Comparison of two Great Arctic Agricultural Empires?" *Russian Journal of Economics* 7 (2): 105–18.

**Lampe, Markus, and Paul Sharp.** 2014. "Greasing the Wheels of Rural Transformation? Margarine and the Competition for the British Butter Market." *Economic History Review* 67 (3): 769–92.

**Lampe, Markus, and Paul Sharp.** 2015. "How the Danes discovered Britain: The International Integration of the Danish Dairy Industry before 1880." *European Review of Economic History* 19 (4): 432–53.

**Lampe, Markus, and Paul Sharp.** 2017. "A Quest for Useful Knowledge: The Early Development of Agricultural Accounting in Denmark and Northern Germany." *Accounting History Review* 27 (1): 73–99.

**Lampe, Markus, and Paul Sharp.** 2018. *A Land of Milk and Butter: How Elites Created the Modern Danish Dairy Industry*. Chicago: University of Chicago Press.

**Lampe, Markus, and Paul Sharp.** 2019. "Accounting for the Wealth of Denmark: A Case Study of Smithian Growth Using the Emergence of Modern Accounting in Danish Dairying." *European Journal of the History of Economic Thought* 26 (4): 659–97.

**Larsen, Ulla M.** 1982. "A Quantitative Study of Emigration from Denmark to the United States, 1870–1913." *Scandinavian Economic History Review* 30 (2): 101–28.

**Lee, Everett S.** 1966. "A Theory of Migration." *Demography* 3 (1): 47–57.

**Leisner, Jorgen J.** 2005. "Weeds, Heat and Pure Cultures–On the Differential Success of New Technologies in the Danish and American Creamery Industries in the 1890s." *Food Policy* 30 (4): 419–33.

**Lissoni, Francesco** 2018. "International Migration and Innovation Diffusion: An Eclectic Survey." *Regional Studies* 52 (5): 702–14.

**Longhi, Simonetta, Peter Nijkamp, and Jaques Poot.** 2005. "A Meta-Analytic Assessment of the Effect of Immigration on Wages." *Journal of Economic Surveys* 19 (3): 451–77.

**Mackintosh, Jette.** 1990. "Ethnic Patterns in Danish Immigrant Agriculture: A Study of Audubon and Shelby Counties, Iowa." *Agricultural History* 64 (4): 59–77.

**Mackintosh, Jette.** 1992. "Elk Horn-Kimballton–The Largest Danish Settlement in America." In *Danish Emigration to the U.S.A.*, edited by Birgit F. Larsen and Henning Bender, 157–74. Aalborg, Denmark: Danes Worldwide Archives.

**Mackintosh, Jette.** 1993. "The Lure of Prosperity: Economic Development among Danish Immigrants to Iowa." In *On Distant Shores: Proceeding of the Marcus Lee Hansen Immigration Conference*, edited by Birgit F. Larsen, Henning Bender and Karen Veien, 177–90. Aalborg, Denmark: Danes Worldwide Archives.

**McLaughlin, Eoin, and Paul Sharp.** 2021. "Competition between Organisational Forms in Danish and Irish Dairying Around the Turn of the Twentieth Century." *Business History* 63 (2): 314–41.

**Moser, Petra.** 2005. "How do Patent Laws Influence Innovation? Evidence from Nineteenth-Century World's Fairs." *American Economic Review* 95 (4): 1214–36.

**Moser, Petra, Alessandra Voena, and Fabian Waldinger.** 2014. "German Jewish Émigrés and US Invention." *American Economic Review* 104 (10): 3222–55.

**Nunn, Nathan, and Diego Puga.** 2012. "Ruggedness: The Blessing of Bad Geography in Africa." *Review of Economics and Statistics* 94 (1): 20–36.

**Nunn, Nathan, and N. Qian.** 2011. "The Potato's Contribution to Population and Urbanization: Evidence from a Historical Experiment." *Quarterly Journal of Economics* 126 (2): 593–650.

**Olmstead, Alan L., and Paul W. Rhode.** 2008. *Creating Abundance: Biological Innovation and American Agricultural Development*. Cambridge, UK: Cambridge University Press.

**Olsson, Ola, and Douglas A. Hibbs, Jr.** 2005. "Biogeography and Long-Run Economic Development." *European Economic Review* 49 (4): 909–38.

**O'Rourke, Kevin.** 2006. "Late Nineteenth-Century Denmark in an Irish Mirror: Land Tenure, Homogeneity, and the Roots of Danish Success." In *National Identity and the Varieties of Capitalism: The Danish Experience*, edited by John L. Campbell, John A. Hall and Ove K. Pedersen. 159–96. Montreal, Canada: McGill-Queen's University Press.

**O'Rourke, Kevin.** 2007. "Culture, Conflict and Cooperation: Irish Dairying before the Great War." *Economic Journal* 117 (523): 1357–79.

**O'Rourke, Kevin.** 1997. "The European Grain Invasion, 1870-1913." *Journal of Economic History* 57 (4): 775–801.

**Ortega, Francesc, and G. Peri.** 2009. "The Causes and Effects of International Migrations: Evidence from OECD Countries 1980–2005." NBER Working Paper 14833.

**Ottinger, Sebastian** 2020. "Immigrants, Industries, and Path Dependence." Unpublished.

**Pedersen, E. K.** 1992. "An Outline of the Historiography of Danish Emigration to America." In *Danish Emigration to the U.S.A*, edited by Birgit F. Larsen and Henning Bender, 190–209. Aalborg, Denmark: Danes Worldwide Archives.

**Pedersen, Jan.** 1999. *Teknologisk Udvikling i Maskinindustrien: Burmeister & Wain 1875–1939*. Lyngby: Polyteknisk Boghandel og Forlag.

**Peri, Giovanni.** 2012. "The Effect of Immigration on Productivity: Evidence from US States." *Review of Economics and Statistics* 94 (1): 348–58.

**Putterman, Louis.** 2008. "Agriculture, Diffusion and Development: Ripple Effects of the Neolithic Revolution." *Economica* 75 (300): 729–48.

**Quispe-Agnoli, Myriam, and Madeline Zavodny.** 2002. "The Effect of Immigration of Output Mix, Capital, and Productivity." E*conomic Review- Federal Reserve Bank of Atlanta* 87 (1): 17–27.

**Rambachan, Ashesh, and Jonathan Roth.** 2023. "A More Credible Approach to Parallel Trends." *Review of Economic Studies* 90 (5): 2555-91.

**Rauch, James E., and Vitor Trindade.** 2002. "Ethnic Chinese Networks in International Trade." *Review of Economics and Statistics* 84 (1): 116–30.

**Rocha, Rudi, Claudio Ferraz, and Rodrigo R. Soares.** 2017. "Human Capital Persistence and Development." *American Economic Journal: Applied Economics* 9 (4): 105–36.

**Rodríguez-Pose, Andrés, and Viola von Berlepsch.** 2015. "European Migration, National Origin and Long-term Economic Development in the United States." *Economic Geography* 91 (4): 393–424.

**Rogers, Elwin E.** 1978. "'Creamery Fever' among the Scandinavians in Grant County before WWI." *South Dakota History* 9: 24–35.

**Ruggles, Steven, Sarah Flood, Ronald Goeken, Josiah Grover, Erin Meyer, Jose Pacas, and Matthew Sobek.** 2018. "IPUMS USA: Version 8.0 [dataset]." Integrated Public Use Microdata Series. https://doi.org/10.18128/D010.V8.0.

**Sequeira, S., Nathan Nunn, and N. Qian.** 2020. "Immigrants and the Making of America: The Short- and Long-Run Effects of Immigration during the Age of Mass Migration." *Review of Economic Studies* 87 (1): 382–419.

**Siczewicz, Peter.** 2011. "U.S. Historical Counties. Dataset" In *Atlas of Historical County Boundaries*, edited by J. H. Long. Chicago: The Newberry Library.

**Sundstrom, Marvin.** 1986. "Technological Transfer: The Case of Canadian Involvement in the New Zealand Dairy Industry, 1880-1920." *Journal of Rural Studies* 2 (2): 103–16.

**Sørensen, A. C.** 1908. "Danske i Amerikansk Landbrug of Mejeri." In *Danske i Amerika*, Vol. 1, edited by P. S. Vig, 163–326. Minneapolis, MN: C. Rasmussen Publishing Company.

**Turner, Frederick Jackson.** 1920. *The Frontier in American History*. New York: Henry Holt and Company.

**US Department of Agriculture, Natural Resources Conservation Service.** 2006. *Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin*. Washington, DC: US Department of Agriculture.

**US Census Bureau.** 1883. *Report on the Manufactures of the United States at the Tenth Census, 1880*. Washington, DC: Government Printing Office.

**US Census Bureau.** 1895. *Report on Manufacturing Industries in the United States at the Eleventh Census: 1890*. Washington, D.C.: Government Printing Office.
**US Census Bureau.** 1902. *Census Reports Volume IX, Twelfth Census of the United States, 1900-Manufactures*. Washington, DC: United States Census Office.
**US Census Bureau.** 1913. *Thirteenth Census of the United States, 1910, volume X- Manufactures*. Washington, DC: Government Printing Office.
**US Census Bureau.** 1928. *Fourteenth Census of the United States, 1920, Volume X- Manufactures*. Washington: Government Printing Office.
**Vig, Peter S.** 1908. *Danske i Amerika, Vol. 1*. Minneapolis, MN: C. Rasmussen Publishing Company.
**Vig, Peter S.** 1916. *Danske i Amerika, Vol. 2*. Minneapolis, MN: C. Rasmussen Publishing Company.