Robert M. Schwartz

Rail Transport, Agrarian Crisis, and the Restructuring of Agriculture

France and Great Britain Confront Globalization, 1860–1900

During the late nineteenth century the transport revolution and growing agricultural output, especially in North America, engendered an agrarian crisis (1878–96) when intensifying international competition in foodstuffs led to dramatic price declines, particularly in wheat and other cereals. This comparative study of the process in Britain and France examines regional and local patterns of rural change in relation to the expansion of railways, the agrarian crisis, and the responses to the crisis by the governments and farmers of the two countries. Using spatial statistics and geographically weighted regression (GWR) to identify spatially varying relationships, it offers a new approach and results. Case studies of Dorset County in England and the Allier Department in France show that railways facilitated the shift from cereal production to livestock and dairy farming during the era of agrarian crisis. In Dorset the analysis using GWR provides an explanation for patterns of the agricultural depression that a pioneering article identified but could not explain and thus illustrates the promise of blending narrative and spatial history. Further, it argues that in France
expansion and the construction of a secondary network reduced regional disparities in 
rail service and likely in agricultural productivity, too. More broadly, it concludes that 
the differing political economies of Britain and France led to different trade and rail-
way policies during the crisis and to different agrarian outcomes in which agricultural 
productivity declined in Britain and improved in France.

The growth of the American wheat trade . . . and the developments it has 
made are one of the wonders of the world. . . . With the introduction of rail-
ways . . . new fields were opened up as if by magic.

If agricultural depression has not been so severely felt in France as in 
England during the last three or four years it has caused a much louder cry 
of distress. (Royal Commission on Agriculture, 1882 [John Clay, H. M. 
Jenkins])

We have received a copy of the Second Report of the Royal Commission 
upon the Depression in Trade. . . . The report then proceeds: “The indus-
tries which we selected as the most suitable for our immediate consideration 
were a) the coal and iron trades; b) the several branches of the textile industry; 
c) agriculture; and d) shipping.” (Daily News [London], April 23, 1886)

However wondrous was the growth of the American wheat trade, it seemed, 
in the minds of many British and French farmers, an enemy at their own 
farm gates. In reality, the American wheat trade was the leading sector in the 
globalization of agriculture during the second half of the nineteenth century. 
In western Europe the vast expansion of international trade in foodstuffs 
engendered a prolonged agrarian crisis during the 1880s and 1890s. Part of 
the great depression in trade generally, the agrarian crisis brought a dramatic 
reversal in the fortunes of French and British farmers. The arrival on Euro-
pean markets of a growing surplus of foodstuffs, chiefly from the United 
States and Canada, depressed prices and agricultural incomes, undermining 
the profitability of large farms in particular and generating political pressure 
on governments to help protect farm incomes (Lhomme 1970; Tracy 1989; 
Koning 1994; Coclanis 2003).

The origin, character, and geographic extent of the crisis were in many 
ways determined by the nineteenth-century transport revolution. In addi-
tion to steamships and the telegraph, rail transport was a major element in
that revolution, and its effects on agriculture varied over time and space. The advent of rail transport in the countryside was more complicated than is generally thought. Early on, it stimulated economic growth by opening new opportunities for British and French farmers to market their surplus production in regional and national markets. In time, however, rail freight also increased competition and depressed agricultural prices. Both effects accelerated a spatial reorganization of agriculture in which mixed farming gave way to specialized production. In the United States railways helped produce similar results with far-reaching international consequences, notably by facilitating the westward movement of cereal production into Wisconsin, Kansas, and Nebraska and enabling the shipment of growing surpluses to New York for export to Europe. In response to the consequent intensifying competition and steep fall in prices, the British government held to its policy of laissez-faire and open agricultural markets while allowing railway freight rates to be determined mainly through the competition of private rail companies. In contrast, the French state introduced not only protective tariffs but a major program of railway expansion to further the development of its vast agrarian section and to better integrate its very large rural population.

If these aspects of the story are well known, there are others that this article investigates anew. Although the differing policies regarding railway development in Britain, France, the United States, and Germany have been well examined (Dobbin 1994; Dunlavy 1994; Caron 1997, 2005; Mitchell 2000), the following comparative study of their implementation in rural Britain and France offers a new approach and results. New is the use of geographic information system (GIS) data and spatial statistics to carry out geographic and historical analysis. These tools are combined with a comparative framework to examine the effects of railways and agrarian crisis at the multiple scales of geographic interconnectivity: international, national, regional, and local. The aim is not to reexamine national economic performance, the contribution of railways to national economic growth and international competitiveness, or the modeling of trade flows. Such work in economics and economic history is enjoying a renaissance of late due to recognition that the long nineteenth century (1800 to 1914) was an era of globalization par excellence. Important and interesting, such work is nonetheless typically abstract, commonly rests on aspatial statistical methods, and favors the study of aggregate or global trends (O’Rourke 1997; O’Rourke and Williamson 1999, 2002, 2004; Ejrnaes and Persson 2000; Persson 2004; Jacks 2006). This article
looks less to overall trends and averages than to regional and local variations, to the specific and shifting geographies of historical change. It concentrates on identifying regional and local patterns of rural change in relation to the expansion of railways, the agrarian crisis, and the responses to the crisis by the governments and farmers of Britain and France. It endeavors to illuminate particular mechanisms of change on the ground. And where the data permit, it uses spatial statistics and geographically weighted regression (GWR) to identify spatially varying relationships to help clarify problems that to date have received little systematic attention (Fotheringham et al. 2002).

After comparing the evolution of national rail networks, this essay presents an argument centered on case studies showing the extent to which railways facilitated the shift from cereal production to livestock and dairy farming during the era of agrarian crisis. In the case of Dorset (England), the analysis using GWR provides an explanation for patterns of the agricultural depression that a pioneering article identified but could not explain (Perry and Johnston 1972). It thereby illustrates the promise of this line of research. Further, it suggests that in France railway expansion and the construction of a secondary network, which connected rural communities with major towns and the main rail network, reduced regional disparities in rail service and likely in agricultural productivity, too. The essay concludes by considering more broadly how the differing political economies of Britain and France led to different trade and railway policies during the crisis and to different agrarian outcomes in which agricultural productivity declined in Britain and improved in France.

Read All about It: A Day in the Era of Global Transformation

To appreciate specific components of the crisis, we need only leaf through the pages of a contemporary newspaper, the Daily News of London. The issue for Friday, April 23, 1886—the eve of the Easter weekend—takes us into that era of global transformation. Reflecting a priority on advertising revenue, the front page heralds all manner of goods and services, from iron-rich tonics and soap for a bright clear complexion to luxury steamship travel. Business news and figures on international trade begin on page 2, while timely political issues of national and international importance—armed tensions between
the freight rates for shipping grain and cotton from New York to Liverpool shares in railway stocks (the Pennsylvania Railroad, the Canadian Pacific, and wheat prices weakened, as did those of flour. Over the past three days, a firm opening, U.S. markets closed lower on the day before Good Friday. Trading in cotton and sugar was quiet, while petroleum held steady, and wheat prices weakened, as did those of flour. Over the past three days, shares in railway stocks (the Pennsylvania Railroad, the Canadian Pacific, the Northern Pacific, and others) remained unchanged. Unchanged, too, were the freight rates for shipping grain and cotton from New York to Liverpool. Prices of butter imported from Friesland, Denmark, Brittany, and Normandy feature prominently in the long list. At the central London fish market, American oysters are cheaper than those from the Channel Islands and Brittany, 6 pence per dozen versus 8 to 10 pence, respectively. Imports of foreign livestock and fresh meat are also reported. During the past week in Liverpool, arrivals of cattle, quarters of beef, and sheep from the United States and Canada were substantial, with “a decrease in the importation of cattle and mutton, but an increase in the shipments of beef.”

Foreign stock and commodity markets: Page 5 features expanded news of the American market and some headlines from the Bourse de Paris. After a firm opening, U.S. markets closed lower on the day before Good Friday. Trading in cotton and sugar was quiet, while petroleum held steady, and wheat prices weakened, as did those of flour. Over the past three days, shares in railway stocks (the Pennsylvania Railroad, the Canadian Pacific, the Northern Pacific, and others) remained unchanged. Unchanged, too, were the freight rates for shipping grain and cotton from New York to Liverpool.
or London. On the Bourse de Paris, French railway shares moved slightly upward, and shares in the Suez Canal strengthened. A verdict in a lawsuit over imported guano attests to the growing importance of fertilizer in international markets.

*Economic depression and government response:* Finally, on page 6 we find reports of major political issues in the United Kingdom. At the top of the page, a headline announces that the Second Report of the Royal Commission on the Depression in Trade has just been published. In the judgment of the commission, the coal and iron trades, the textile industry, shipping, and agriculture were the industries most seriously affected. The depression in agriculture, we learn, has adversely affected the iron industry, because orders for agricultural machinery have dropped off.

**Globalization, Railways, and Agriculture in the 1880s and 1890s**

Here, then, in the *Daily News* is a telling sketch of the conjuncture in the 1880s of the transport and communication revolutions, the globalization of agricultural commodities, and widespread agrarian distress that ensued in Britain. Interestingly, the issue of April 1886 attests to the rapid transmission of price signals among interdependent markets in various parts of the world; to the use of the telegraph and newspapers to distribute market information with unprecedented speed and geographic range; and to the role of railways and steamships in providing high-speed and less costly transportation of people, goods, and information (Ahvenainen 1986; Kaukianinen 2001; Jacks 2006).³

Less evident in the *Daily News* are the far-reaching effects of this conjuncture. The swift diffusion of price information across continents affected not only commerce and trade, as in the past, but also production itself. On a broader scale than ever before, farmers had to adjust their production to the dictates of increasingly integrated world markets in agriculture, freight rates, fertilizers, and other commodities. However accustomed they may have been to market competition in the village, the region, and the nation, western European farmers now found themselves competing with producers in the American Midwest and Canada. Thanks to the speed and carrying capacity of railways and steamships, the cost of shipping the growing American surpluses in cereal grains, cattle, and meat to Liverpool, London, Marseille, and...
other European port cities fell substantially, as did the rates for forwarding imported foodstuffs to urban markets within particular countries. On both sides of the Atlantic Ocean, prices of cereals, cattle, and meat converged and dropped dramatically. The converging price of wheat fell the most (Lhomme 1970: 533–36; Tracy 1989: 17–19, 27; Perren 1995: 7–10; Collins 2000: 138–44, 146–49, 158–67) (see figure 1).

To understand the role of railways in this common outcome and in the British and French responses to the crisis, it is important to note first how railway expansion in the two countries differed in timing and character. In Britain during the 1860s and 1870s the rail network reached into the countryside of England and Wales—a decade or so earlier than in France. By 1871 about 20 percent of rural parishes—the smallest unit of British administration—had a station and direct access to rail service, a proportion that grew only slowly over the coming years (Simmons 1986: 312–14; Gregory and Henneberg in this issue). At the level of the registration district—larger units centered on a market town and comprising a number of parishes—rail accessibility was impressive. Here the construction of branch lines turned the fortunate small towns with stations into thriving market centers, and
farmers in the area enjoyed greater opportunities to sell their produce in larger urban markets. By 1876 in England and Wales there were some 4,190 rail stations in operation, and relatively few rural districts lacked some sort of rail connection. This density of service was remarkable. It was also a marker of inefficiency. Built and financed by private companies, the British rail system tended to overexpand owing to intense competition. In the effort to secure and expand regional dominance, rail companies duplicated services in some regions and constructed unprofitable lines in a competitor’s domain or in the remote regions of its own (Casson 2008, 2009). Nonetheless, the rail system in England and Wales was the leading European example of private capital’s capacity to alter spatial relations of production and consumption. (On railway finance, see Simmons 1978.)

Across the English Channel, the French rail system mirrored Britain’s different political economy, being a mixture of state tutelage and private enterprise, of government and private financing. In keeping with a tradition of state dirigisme and the view that the rail system was a public good, it was the state and its engineers of the Ponts et Chaussées (Bridges and Roads Department) who, from the 1840s on, designed and supervised the national system. Exercising this authority, the central government granted exclusive concessions to private companies to construct and operate regional networks. In contrast to Britain, granting regional monopolies was considered the appropriate way to balance private interest and the public good by reducing potential inefficiencies from competition for the same business (Dobbin 1994; Caron 1997). In rural France rail service on a small scale began to reach the countryside in the late 1870s, but it was only with the construction of local lines from the 1880s that most of rural France eventually enjoyed accessible service (Price 1983; Wolkkowitsch 1992). Geographically, regional disparities in rural rail service remained more pronounced in France than in Britain until, beginning in the 1880s, the Third Republic stepped in to reduce them.

With this background, we can turn to the effects of railway expansion in the countryside. In agriculture expanding rail transport altered the geography of market relations and accelerated regional specialization. In Britain, for instance, spatial restructuring occurred in cattle shipments to London. In this trade Middlesex farmers had long enjoyed the advantage of proximity to the capital, and until the 1860s this advantage was reinforced by the growth of railways radiating into the Home Counties around London. By the 1870s,
however, the expansion of rail service into the West Country eliminated the Home County advantage, for it allowed West Country farmers, who enjoyed lower costs in land and labor, to send large numbers of livestock to London and at lower prices than Middlesex farmers could manage. This spatial restructuring of market hierarchy also took place in the trade in perishable produce, such as fresh milk, vegetables, and fruit. As rapid rail transport became accessible in Cornwall, farmers there, blessed with a warmer climate, captured more of the London market by shipping fresh vegetables to the city earlier in the season. In Worcestershire existing fruit and vegetable gardens were much expanded, and new perishables were introduced: strawberries in 1870 and tomatoes in 1884 (Perren 2000).

In France, as in Britain, expanding rail transport accelerated the change from mixed farming and regional self-sufficiency to regional specialization and greater participation in the national market. In France regional specialization was particularly pronounced in fresh produce, wine production, and cattle and dairy farming. After 1850 the profitability of stock raising outpaced that of cereal cultivation, so that, even before the collapse of cereal prices, more cropland was increasingly converted to pasture. Meanwhile the southern province of Languedoc was virtually transformed into a vast vineyard producing huge quantities of wine shipped to Paris and the north by rail (Clout 1980: 170; 1983: 71, 80–81, 104, 137; Planhol and Claval 1994: 245, 261–66; Caron 1997).

**Responses to the Agrarian Crisis**

When the crisis struck in Britain, concerns to relieve agrarian distress grew and intensified, but they failed to move the government to alter its policies affecting agriculture, free trade, and the increasing volume of imported foodstuffs. This did not mean that Parliament ignored the problem. As reported in the *Daily News* of London, royal commissions of Parliament gathered evidence on the depression in industry and agriculture. In particular, two royal commissions on agrarian distress (those of 1882–86 and 1894–97) carried out vast, methodical investigations into English and Welsh agriculture, and their published findings grew to a dozen massive volumes. Although much hand-wringing took place in the House of Commons and its committee rooms and a revived protectionist movement arose in the 1890s, the government held the line against protectionism and maintained free trade.
In the royal commissions’ investigations, the importance of rail transport figured prominently. Its availability was assessed in every district under investigation, and witnesses questioned on-site were quick to decry onerous freight charges, some claiming that rates for carrying imported products were lower than those for domestic goods. A follow-up investigation in 1886–87, however, showed that this claim was largely groundless, though the investigation itself likely pressured some rail companies to ease up on some higher rates (British Parliamentary Papers 1887). Richard Jefferies (1889: 233), the celebrated journalist of English rural life, took up the cause for transport reform, criticizing not only high freight charges but the insufficient rural reach of the railway system in place:

One need only go to the nearest greengrocer’s to obtain practical proof of it. The apples he sells are American. The farmers in New York State or Massachusetts can grow apples, pack them in barrels, dispatch them two thousand eight hundred miles to Liverpool, and they can then be scattered all over the country and still sold cheaper than the fruit from English orchards. This is an extraordinary fact, showing the absolute need of speedy and cheap transit to the English farmer if he is to rise again. Of what value is his proximity to the largest city in the world—of what value is it that he is only ninety miles from London, if it costs him more to send his apples about ninety miles than it does his American kinsman very nearly three thousand?5

However passionately they were put, such arguments as Jefferies’s had little to no effect. Parliament passed the Light Railway Bill in 1896 in the hope of expanding freight and passenger service to depressed localities. Nevertheless, the implementation of the plan, which was left to private enterprise, proved disappointing (Cherry and Sheail 2000: 1714).

Besides protection, farmers and merchants everywhere appealed for lower freight rates. In France grain merchants and other middlemen were most likely to press the issue, both on their own and through local chambers of commerce and regional general councils. As for farmers themselves, large producers and stock raisers were more apt to win concessions than small farmers were, though the voices of small producers began to make an impact via the agricultural societies that emerged throughout the country in the 1880s (Price 1983: 249; Baker 1999: 240–81). Meanwhile, in small communities without rail service citizens pressed to obtain it through petitions and
the ballot box. And if success seemed within reach, local authorities were willing to take on debt and raise taxes to secure a rail connection.

During the early years of the Third Republic, these demands from below converged with initiatives from above. As the early signs of economic depression appeared in the late 1870s, ministers and deputies committed the Third Republic to a major expansion of railways with the aim of modernizing the country’s vast agrarian economy. Introduced in 1878 by the minister of public works, Charles Freycinet, the program provided not only for the enlargement of the national rail system but also for the state-subsidized construction of a large secondary network. Designated “lines of local interest” (lignes d’intérêt local), they would connect small towns and villages to the seats of cantons and departments and thereby to the main lines of the national network. A vehicle of economic development, the program also aimed at consolidating the political base of the new republic by securing the loyalty of the country’s large rural population (Gonjo 1972; Caron 2005: 86, 361–70).

As for protection, under pressure from large farmers and merchants, the government reluctantly imposed tariffs on imported livestock, meat, and wine in 1881 and on cereals in 1885 (Price 1983: 339; Tracy 1989: chap. 3). Meanwhile, the part of the Freycinet program devoted to the secondary rail network began to take hold in the 1890s as the rural communities favored with new lines multiplied across France and met with popular enthusiasm. From the turn of the century to the Great War, the network grew tremendously, and in 1928 it reached its maximum extent of 20,000 kilometers. Given the size of the main system of 40,800 kilometers near its peak in 1915, the secondary network represented a substantial addition to the national total. As we shall see, its contribution to agrarian change was significant.

**Railways, Dairy Farming, and Crisis in the County of Dorset**

The effects of rail transport and agrarian crisis can be seen more clearly in a brief study of events in Dorset County. There the first railways appeared in the late 1840s, and the network of lines and stations was all but complete by the 1870s. By that time it was anchored in the county seat of Dorchester and inscribed near the edges of the county, such that no service was available in the country’s spacious central region. From the main circuit there were direct connections to London, and branch lines served the seaside
Figure 2  Railways, stations, and terrain in Dorset, 1880s
Source: Created by Robert M. Schwartz.
Table 1  The decline of cereal farming in Dorset in relation to England and Wales

<table>
<thead>
<tr>
<th>Year</th>
<th>England and Wales</th>
<th>Dorset</th>
<th>Difference from national mean</th>
<th>Index of density 1869 = 100</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of counties</td>
<td>Mean density(^a)</td>
<td>Mean density(^a)</td>
<td>County density(^a)</td>
</tr>
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<td>55</td>
<td>22.0</td>
<td>18.2</td>
<td>-3.8</td>
</tr>
<tr>
<td>1871</td>
<td>55</td>
<td>21.8</td>
<td>18.7</td>
<td>-3.1</td>
</tr>
<tr>
<td>1875</td>
<td>55</td>
<td>21.3</td>
<td>18.4</td>
<td>-2.9</td>
</tr>
<tr>
<td>1885</td>
<td>55</td>
<td>18.4</td>
<td>15.5</td>
<td>-2.9</td>
</tr>
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<td>1901</td>
<td>55</td>
<td>15.2</td>
<td>13.0</td>
<td>-2.2</td>
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<tr>
<td>1910(^b)</td>
<td>43</td>
<td>17.1</td>
<td>12.2</td>
<td>-4.9</td>
</tr>
</tbody>
</table>

Sources: British Parliamentary Papers, Agricultural Returns for Great Britain, 1869, 1871, 1875, 1885, 1901, 1910.
\(^a\)Density of cereal production in acres devoted to cereal crops per 100 acres of county land.
\(^b\)The 1910 figures for Wales are not included.

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resort at Weymouth, the harbor and quarries in Portland, and the fishing port of Poole. From the 1840s to the 1870s the accessibility of rail transport for rural producers improved as the completion of lines and the opening of new stations reduced the distance between farms and shipping points. Significant disparities, however, remained: farmers in the lowland valleys were well served, while those in the central uplands of the county center were not (see figure 2).

These disparities were one factor that shaped farmers’ responses to the agrarian crisis and the varied evolution of local economies. In Dorset during the agrarian crisis, proximate rail transport favored the retreat from cereal farming and the further development of dairy farming, resulting in a degree of regional specialization more pronounced in Dorset than in the nation at large (see tables 1–2).

These changes in agrarian production—and the role of rail transport in shaping them—affect the geography of local and regional population change. Although stock raising and dairy farming typically reduced the demand for agricultural labor, as compared to the greater labor requirements of cereal production, the higher profits of the fresh milk trade brought a degree of prosperity that could stabilize or increase a locality’s population. To be profitable in the years before the late 1890s and the widespread use of refrigeration, dairy farms had to be near stations. In areas lacking good rail transport, farmers might raise dairy cows to provide milk for local consump-
Table 2  The growth of dairy farming in Dorset in relation to England and Wales

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of counties</th>
<th>Mean density</th>
<th>Standard</th>
<th>County density</th>
<th>Difference from national mean</th>
<th>Index of density 1869 = 100</th>
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<tbody>
<tr>
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<td>55</td>
<td>4.9</td>
<td>2.3</td>
<td>7.1</td>
<td>2.2</td>
<td>100.0</td>
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<tr>
<td>1871</td>
<td>55</td>
<td>4.7</td>
<td>2.3</td>
<td>7.2</td>
<td>2.5</td>
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<tr>
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<td>2.5</td>
<td>7.8</td>
<td>2.7</td>
<td>104.1</td>
</tr>
<tr>
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<td>55</td>
<td>5.8</td>
<td>2.6</td>
<td>8.7</td>
<td>2.9</td>
<td>118.4</td>
</tr>
<tr>
<td>1901</td>
<td>55</td>
<td>5.8</td>
<td>2.8</td>
<td>8.4</td>
<td>2.6</td>
<td>118.4</td>
</tr>
<tr>
<td>1910b</td>
<td>43</td>
<td>6.3</td>
<td>3.1</td>
<td>9.5</td>
<td>3.2</td>
<td>128.6</td>
</tr>
</tbody>
</table>

Sources: British Parliamentary Papers, Agricultural Returns for Great Britain 1869, 1871, 1875, 1885, 1901, 1910. Figures for 1871, 1901, and 1910 were kindly supplied by Humphrey Southall.

*Density of dairy farming in number of milk cows per 100 acres of county land.

*The 1910 figures for Wales are not included.

Examination of parish-level data across the county and over time helps clarify the interconnections of rail transport, agrarian practice, and demographic change. A GWR analysis shows that during the 1880s, the most severe decade of agrarian depression, parishes closer to railway stations tended to have higher rates of population growth than those farther afield and that the inaccessibility of rail service often went hand in hand with pronounced village depopulation. (See table 3 and figure 3, showing the close spatial correspondence between the smoothed rates of population growth in the 1880s with the predicted rates of the GWR analysis for the same period.)

That the relative prosperity of dairy farming—as compared to arable farming—likely stemmed rural depopulation is borne out in a comparison of intercensal population change in three Dorset parishes from 1841 to 1911 (see figure 4). The parish of West Knighton, in the south near Dorchester, and that of Marnhull, in the northeast of the county, were both located in well-watered valleys where dairy farming predominated, and both had rail stations near at hand. Located in the central chalk uplands, Alton Pancras found itself in a considerably different situation. There cereal and root-crop...
Table 3  The effect of rail station proximity and terrain elevation on parish population change from 1881 to 1891

Comparison of multiple regression analyses

<table>
<thead>
<tr>
<th>Variable</th>
<th>Type of analysis</th>
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<td>OLS</td>
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<tr>
<td></td>
<td>GWR</td>
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<tr>
<td>Cases to fit (N)</td>
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<td>283</td>
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<td>Adjusted $R^2$</td>
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<td>.59</td>
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<tr>
<td></td>
<td>$p$-values</td>
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<tr>
<td>Intercept</td>
<td>Not significant ($&gt; .10$)</td>
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<td></td>
<td>.00</td>
</tr>
<tr>
<td>Distance from station (in meters)</td>
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<td>.00</td>
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</tbody>
</table>

*Population change = distance from the closest railway station + terrain elevation (standard deviation).

Five number summaries of GWR regression coefficients

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Minimum</th>
<th>Lower Quartile</th>
<th>Median</th>
<th>Upper Quartile</th>
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<tr>
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<td>0.050975</td>
<td>0.002974</td>
<td>0.035119</td>
<td>0.245438</td>
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<tr>
<td>Distance from station (in meters)</td>
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<td>-0.000011</td>
<td>-0.000005</td>
<td>0.000004</td>
<td>0.000035</td>
</tr>
<tr>
<td>Standard deviation of mean terrain elevation (in meters)</td>
<td>-0.010577</td>
<td>-0.001694</td>
<td>-0.000219</td>
<td>0.001032</td>
<td>0.011019</td>
</tr>
</tbody>
</table>

Notes: Unlike ordinary least squares regression (OLS), GWR fits a number of regression lines to the data, each line being the best fit for a spatial cluster of cases in the study area. To calculate the GWR results, a moving window proceeds across the study area, using an algorithm to determine the units that comprise the cluster of cases to which a best-fitting regression line is fitted. The general aim of GWR is twofold: to determine whether there are spatially varying relationships of statistical significance among the specified variables for the study area and, when such relationships exist, to provide a measure of the total variance explained by the independent variables ($R^2$) and estimates of the coefficients for each term in the regression equation. The comparison between OLS and GWR results provides a good indication of the presence or absence of spatially varying relationships. The five-number summaries above indicate a range of the coefficient estimates. For study and interpretation, the mapping of GWR results complements the numerical summaries by offering a visual means of identifying spatial patterns.

farming was the rule, with the closest station a half day’s journey away and hopes for a nearby branch rail line never fulfilled. Although the negative effects of the agrarian crisis on population change were felt in all three parishes, West Knighton and Marnhull weathered the crisis more successfully than isolated Alton Pancras did. However much the inhabitants of the more favored parishes complained about high rates for rail carriage, the economic
Figure 3  Population change in the 1880s
Source: Created by Robert M. Schwartz.
Montpellier-Marseille complex formed a hub for the trade in mass-market
and Montpellier stand out as remarkable, if understandable, exceptions. The
in terms of rail transportation. In the south (le Midi) the cities of Bordeaux
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sent clusters of cantons where rail transport was unusually dense; those in
remained to be done in this regard, as figure five lp shows. Areas in red repre-
by two lp percent from one lp/seven lp/five lp to one lp/nine lp/zero lp/two lp (Perry and Johnston one lp/nine lp/seven lp/two lp: three lp/one lp/zero lp). Proximate
Further, in the county as a whole the agrarian population actually expanded
bene/f_i  ts of railways helped sustain their livelihoods and village populations.
Figure four lp Population change in three Dorset parishes
Source: Created by Robert M. Schwartz.
Reducing Economic Disparities between the North and the South in France
One of the aims of the Freycinet program was to reduce regional disparities in rail service that were particularly pronounced in the underserved south. In 1890, with about 80 percent of the French rail system in place, much remained to be done in this regard, as figure 5 shows. Areas in red represent clusters of cantons where rail transport was unusually dense; those in blue, clusters where it was unusually sparse or nonexistent. With few exceptions, the Saint-Malo–Geneva line, dividing the country into a developed north and a less developed west and south, mirrored the economic division in terms of rail transportation. In the south (le Midi) the cities of Bordeaux and Montpellier stand out as remarkable, if understandable, exceptions. The Montpellier-Marseille complex formed a hub for the trade in mass-market
Figure 5  Disparities in rail service, 1891
Source: Created by Robert M. Schwartz.
wines, while Marseille connected world and regional markets to Lyon and Paris via the busiest railway line in the whole country. Imported grain from Russia entered the country at Marseille, while cereals from North America arrived at Bordeaux.

As the gap between rail service in the north and in the south gradually narrowed, so did the gap in agricultural productivity. This narrowing and the upward trajectory of agricultural output and productivity in the south received a boost in 1861, when the Paris-Lyon-Mediterranean Rail Company opened its high-speed express service to transport fresh produce from the Perpignan and Marseille regions to Paris. In the plateaus of the southeast, the new service prompted the creation of new farming areas for perishable fruits and vegetables. Until the phylloxera epidemic struck in the 1870s, the expansion of rail transport in southern regions led to remarkable increases in southern wine production, especially in Languedoc (Caron 1997: 569).

The importance of the Freycinet project for agrarian development in the center and the south can be seen in the Allier, a department south of the Saint-Malo–Geneva line where rail transport was quite modest until 1880 (Russell 2004: chap. 4). With state subsidies, the department constructed a network of narrow-gauge lines (one meter wide) in the late 1880s and 1890s that more than doubled the operational kilometers of the main system (173 km vs. 412 km in 1912) and provided market access to many more communes than were served in 1880 (see figure 6). Comparing figures on land use and heads of livestock in 1881 with those in 1911 demonstrates in particular the relationship between rail transport and market adjustment by small farmers. By and large, farms in communes closer to rail connections tended to be smaller than those at a greater distance, just as the change from grain growing to pasture, dairy cows, and meat cattle was greater in nearby communes than in communes at a greater distance from whistling locomotives. The decision by the Allier’s political leaders to expand railways in order to address agrarian distress and modernize agriculture was bringing the desired result (see figures 7–8).

In sum, by the end of the 1890s, with recovery of the wine industry underway and secondary rail networks like those in the Allier stimulating agrarian change and market integration, the rate of productivity growth of southern agriculture surpassed for the first time that of the northern regions. For the two regions, a significant convergence in yields and total agrarian output per worker was in place (Toutain 1994: 335–36). Railway expansion
in the south doubtless played a role in this, though how large a role in various regions remains to be determined.

Britain and France in Broader Perspective

In conclusion, two broader issues are worth considering. The first concerns the improved viability of small-scale farming. The agrarian crisis arguably undermined the profitability of large farms and created conditions favorable to small and modest-sized farming units. As prices for foodstuffs fell, landlords watched their rental incomes decline, and large farmers employing hired labor had difficulty meeting their expenses for wages. Under these circumstances, smaller farmers using family labor enjoyed a competitive advantage, and stagnant or falling land prices led to the creation of smaller farms through the breakup of larger units. Although more research needs to be
done, available figures for France, Britain, Germany, and the eastern United States tend to substantiate this generalization (Grantham 1975; Tracy 1989; Koning 1994; Collins 2000).

The second point concerns British and French agriculture generally. Recent studies have challenged the view that England’s highly productive agriculture contributed greatly to pathbreaking British industrialization, claiming instead that agricultural growth merely helped feed the increasing population, while imported foodstuffs were increasingly important to close the gap between domestic production and consumer need (Federico 2005: 226–28). Other studies suggest that the British policy of laissez-faire after the 1870s contributed to a decline in agricultural productivity. For France, the characterization of French agriculture as backward and stagnant—and thus a key factor in slow economic growth during the nineteenth century—is no longer persuasive. Indeed, during the second half of the nineteenth century the increase of total factor productivity of French agriculture appears to

**Figure 7** Change in grain cultivation related to proximity to an urban market or railway connection among 24 communes in the Department of the Allier. Source: Created by Robert M. Schwartz.
have been higher than that of British agriculture. There were many reasons for this result. Possibly, one was the French state’s railway initiatives in the 1880s in response to the agrarian crisis. In further work, I hope to gauge the effect of the Freycinet program on productivity growth as compared to that of protective tariffs (Beck 1987).

What seems clear is that the contrasting responses of Britain and France to the globalization of agriculture, and to the agrarian crisis in particular, reflected differences in the political, economic, and demographic characteristics of the two countries. In heavily industrialized and urbanized Britain, the government’s decision to leave domestic agricultural markets open to international competition reflected its recognition that imports were needed to feed its rapidly growing population. Further, it realized that opposing protectionism, or other forms of farm-income support, carried little political risk. The proportion of the rural population in England and Wales had fallen from about 50 percent in 1850 to 28 percent in 1891, and the shrinking agrarian sector came to have a smaller voice in setting national policy.

**Figure 8** Change in dairy cattle related to proximity to an urban market or railway connection among 24 communes in the Department of the Allier

Source: Created by Robert M. Schwartz.
With American and colonial sources of food available and protected by the strongest navy in the world, the growing dependence on imported foodstuffs and the associated drop in food prices appeared less a problem than an overall advantage for the industrial and imperial British economy. Cheaper food benefited both urban and industrial workers, who were increasingly a political force, and the competitiveness of British industries. Britain’s farmers had thus to adjust as best they could to unfavorable market conditions. As a consequence, likely unintended, British agricultural output stagnated, and productivity fell (Koning 1994: 76).

In France state intervention was a long-accepted feature of the nation’s political economy. With a slower rate of industrialization, a significantly larger agricultural sector, and a rural population that still constituted about half of the total in the 1890s, the leaders of the Third Republic addressed the agrarian crisis with a sense of urgency. The defeat by Prussia in 1870 and the growing strength of antirepublican groups and sentiments fortified the government’s desire to consolidate the new regime by winning the support of the relatively vast rural population (Meadwell 2002). With these considerations in mind, the government introduced, somewhat reluctantly, protective tariffs, realizing that conservative landlords and large farmers would likely benefit more than the small farmers who were typically more supportive of the republic. With greater conviction, Freycinet and his supporters launched the ambitious program of rail construction. Unlike tariffs, state subsidies for railway expansion could be targeted to shore up political support. More broadly, a belief was widely shared that the provision of rail transportation was, first and foremost, to serve the public interest. State funds and direction put this belief into action and opened communication with thousands of remote communities. This was a French approach to modernization in an age of intense globalization. It was an approach that liberal economists, then and now, have deemed wrongheaded or inefficient. Whatever the merits of these critiques may be, the French approach likely helped farmers both adjust to intensifying international competition and improve their productivity.

Notes

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1 My research also takes up the relationship between railways and rural population change in England and Wales through net migration. It challenges the notion that railways facilitated rural depopulation by showing that the arrival of railways often stemmed the pace of rural out-migration. Although data on net migration are unavailable for France, my work using intercensal population change suggests a similar outcome, depending in part on rail accessibility.

2 Using records on farm sales, the authors found that the central and southern areas of the county were hardest hit by the depression, but they admitted having little to explain the pattern. Interestingly, they gave no attention to transport and railways in particular.

3 In his study of the multiple factors influencing market integration in the nineteenth century, D. S. Jacks confirms the importance of railways and canals while suggesting that overlooked influences, such as the common use of the gold standard, had a very significant effect on the costs of trade.

4 Figures calculated from a GIS database on British railways, created by Jordi Martí Henneberg, Antonia Valentín, Laura Ortiz, Eloy del Río, and J. Martí-Dominguez, Université de Lleida, Spain, 2007. This GIS is based on the remarkable historical atlas by M. H. Cobb (2003).

5 From the standpoint of economic efficiency, Mark Casson’s research cites excessive expansion into unprofitable branch lines in rural areas as a major reason for the inefficiency of the rail network in England and Wales (Casson 2009). That said, Jefferson’s claim points to issues of importance beyond the mere economic. Rail service in remote or rural communities improved communications, diminished isolation, and likely altered agrarian practice through, for example, the delivery of industrial fertilizers. The circulation of newspapers and improved mail service integrated rural populations into regional and national cultures and no doubt altered their perceptions of the nearest large city, London, and even the empire.

6 The use of GWR for the case of the Allier and other areas in France is not possible for this article, because the data required are not yet complete.
References


