ARGENTINE RAIL DEVELOPMENT AND IRISH MEAT IN BRITAIN, 1857-1910

JAMES KELLY
Senior Sophister

In an in-depth examination of a narrow topic with broad policy implications, James Kelly illustrates the extent to which changes in a single country's competitiveness can affect economies worldwide, through the impact that Argentina's railway development had on Irish meat exports to Britain. He makes the confident case that applying econometric techniques, combined with the study of economic history, is a vitally important tool for understanding market reactions today.

Introduction

One of the most visible legacies of the first phase of globalisation and international capital flows, the railways influence was felt in both the domestic economy integration and world markets. This proposal aims to investigate its impact on the Argentine economy and also on the economies of competing nations during this period. Railways had a substantial influence on other countries, with much being written about their unifying effect in the US market. Could reducing the costs of trade through the introduction of railways in Argentina, lead to a more unified international market?

A further aim of this proposal is to evaluate the influence of infrastructural development, transport in this case, in a previously underdeveloped country and its effect on rivals in an international market, agri-business in this particular case. In a global economy quickly becoming ever more interconnected and urbanized, the concept of long distance exports of food from land abundant to labour intensive urban areas is very relevant. Since the Baltic grain trade in Amsterdam in the late sixteenth century, the concept of sea-borne trade of bulky low value goods changed the pattern of economic integration and production specialization, and has raised the issue of self-sufficiency versus import heavy policies. Although food prices in major world markets are at or near a historical low, there is increasing concern about food security. Despite strides in technology in the industry a new set of exogenous factors (climate change, competition for water, energy, and land) look set to affect food networks and systems for generations to come. Food imports and reliance on international markets look set to continue, and this research topic will offer useful insights into the effects of such developments on both global players and in particular local competitive suppliers.

Admittedly, it would be unrealistic to expect a discovery that would rival the impact the New World had on the international agricultural produce market, however, understanding the market reaction to global shocks in the industry is still important today. This is what this paper aims to achieve.

Objective

To meet the aims addressed above the objective of this proposal is to determine whether the development of the Argentine rail network (holding all other variables constant) influenced the international competitiveness of Irish agricultural produce in Britain (modern day) at the turn of the nineteenth century.

Relationships within the international meat industry can be best described in terms of two complementary regions: one of surplus production and the other of surplus demand. Argentina was 'land abundant' compared to the 'labour intensive' nature of Western Europe at the time. With their abundant land and sparse populations this new economy was self-sufficient and could also provide the rapidly industrialising Europe with large amounts of food. Its agricultural growth was attributed to a European economy with increasing populations and income and the subsequent increase in demand. The British economy required imports and in order supply these imports Argentina required external capital investment. Given Argentina's flat land abundant nature, investment in rail networks was relatively inexpensive and had favourable returns when compared to domestic returns for British investors, even when risk was controlled for (Edelstein, 1984). Aggregately, railway development represented a significant factor of the productivity growth during this period. The agricultural revolution of the pampas increased the total cultivated area in the Argentine economy from approximately 40,000 to 143,000 square kilometres between 1895 and 1914 (Fajgelbaum, 2014).

First we must establish the effect of the railway development on Argentine exports to Britain, then we must see what effect these exports had on the Irish exports to Britain. Two regression should be run to identify these variables: a multiple linear regression and an instrumental variables regression. Most of the railway building occurred in the period 1857 – 1910, and since data for both dependent and explanatory variables are available over all of this time, the time under consideration will be these 53 years. This means that there will be a considerable number of data points in the analysis. Explanatory variables in this analysis include the speed of delivery, and other technological advancements that could have led to an increase in exports, such as the refrigeration shipping method. The effect of railways on Argentine exports acts as the control variable in the instrumental variable regression when researching the effects on Irish exports. For the purpose of this proposal 'meat' will consist of three products; cattle, pig and sheep. Furthermore, price data is not available for all agricultural products in this period, how-

ever it is for the meat ones listed above. Irish agricultural volume and production is influenced primarily by land tenure and the nature of demand for the products (Crotty, 1966). The nature of demand for its products internationally would have stemmed from Britain, and a large shock to supply from increased Argentine beef imports could certainly have had an effect on Irish agricultural volume and produce. Investigating this is the objective of this research proposal.

Literature Review

International Rail Competitiveness: Why Argentina?

By 1914, three quarters of the current rail network of 27,000 miles was in full operation and substantial freight cost reductions were achieved. In 1910, the British capital investments in Argentine rail was £174,464,274. This equalled their entire investment in Argentina twenty years previously and by 1914 British companies accounted for 70 per cent of Argentine rail miles (Gravil, 1985). The factors of production adjusted in response to the agro-pastoral orientation of the economy. Railways were used as a tool for colonization as the eastern provinces were explored, leading to further domestic integration and national efficiency. Table 1 shows the railway mileage expansion of Argentina, 1850-1910.

Year	Argentina
1850	6 (1857)
1860	24
1870	455
1880	1,437
1890	5,750
1900	10,419
1910	17,220

Table 1: Public Railway Mileage, 1850-1910 (Source: Mitchell, 1983)

The export led rail development and level of domestic integration perhaps gave Argentina a competitive advantage over other land-abundant agri-exporters, Australia for instance. The Australian network was far from an integrated one, with each state building their own railways (Perren, 2006). The increase in demand for Argentine beef in Britain was due to a lack of real growth in domestic meat production or imports, coupled with an increase of 4.5 million in population in Britain between 1900 and 1913. Other key developments were supply and commodity adjustments, including the decline in meat exports from the US as their domestic consumption increased, and the introduction of trans-Atlantic ref-

rigerated animal trade.

Argentina's integrated network possessed cheaper animals, lower freight costs and faster deliveries over rivals, and their produce continued to succeed in the British market. The Australian production was seasonal, more susceptible to drought and had institutional defects in distribution. The advantages for Argentina were considerable. As it was compulsory for meat packing product processing to occur in the exporting country, their organised and integrated network was more efficient.

Argentina's efficiency advantages allowed for growth. There was a positive correlation between railway construction and government capacity (Bignon *et al.*, 2015). Through a multiple equilibrium model Bignon, Esteves and Herranz-Loncan estimate that some Latin American nations were stuck in a non-development trap, whereby growth in government revenues and foreign trade were depressed due to insignificant railway development, and similarly, railway development stagnated due to low levels of trade and subsequent scarcity of state resources. The Argentine economy had a competitive advantage in the market, given the British propensity to invest in their developing infrastructure. Their model suggests even a modest capital injection would achieve higher levels of railway density. Revenues triggered railway development, which led to trade, which led to further revenue, making the investment guarantees more credible.

Railways' Influence on the Argentine Economy

Fajgelbaum's paper (2014) uses quantitative methods, and the natural experiment of the Argentine development and integration into world markets in the late-nineteenth century, to investigate the role of internal trade costs in shaping the effects of external integration on the pattern of economic development and welfare within countries. During the period 1869 to 1914, livestock and agricultural exports from Argentina accounted for over 95 per cent of the total value of exports. Fajgelbaum concluded the price of exported agricultural goods declined with remoteness, perhaps giving Argentina a cost advantage from their sparsely populated 'pampas' in the world market. Reductions in transport costs and technology improvements were attributable to the quadrupling of real exports between 1869 and 1910. Reductions in both internal and external trade costs induced changes in the composition of agricultural exports and the allocation of cultivated land across agricultural goods. The distribution of economic activity across sectors and regions were determined by relative prices and productivity, whereby these relative prices depend on both internal and external trade costs.

Perhaps the most noteworthy aspect of this paper is that it did not view the countries in the aggregate, but instead modelled the internal reallocation of resources across regions and sectors central to economic development, thus isolating the influence of the railway development in the 'pampas' on economic development. This allowed them to

identify a simple general equilibrium for the impact of internal geography on the level and pattern of development, which they referred to as the spatial Balassa-Samuelsson effect. A spatial Balassa-Samuelson effect is evident from the results, whereby locations close to a global market have high population densities, high shares of employment in the non-traded sector, high relative prices of non-traded goods, and high land prices relative to wages (resting on the assumption of inelastic demand). This technique further indicates the importance of the rail development on the marginal benefit of 'pampa' infrastructural development. Their analysis underlines the influence of complementary investments in internal infrastructure and technology adoption in determining Argentina's economy response to external integration.

Herranz-Loncon's paper (2013) measures the contribution of railway development, this time to economic growth, in four Latin American countries before 1914. Railway density was quite low in Argentina. This resulted in high land prices relative to wages and cost differentials from the 'pampa's' remoteness. Herranz and Loncon use the Solow model to measure the growth contribution of the new technology in the economy. Interestingly, Oliner and Sichel (2002) have used a disaggregated version of this Solow expression, in which different types of capital and components of total factor productivity growth are distinguished. This adjusted model could help measure the contribution of growth from railway development, from both total factor productivity growth and through the capital effect of investment in railways. The TFP contribution can be split into two sections, the growth from within the sector in question and the growth from the substitution of the previous technology. These theories can be illuminated by comparison between the effects of railways on Argentina and on Britain. Herranz-Loncan (2006) show that the first British railways had no great cost advantage over waterways when implemented initially. In contrast, levels of growth in Argentina from the railways were much higher, because previous to their introduction there were no viable alternatives. It can then be concluded that the difference of a growth contribution of a new technology should be included in the total factor productivity term.

Herranz-Loncon (2013) go on to investigate the contribution of railways to economic growth by using a capital term, estimates beginning in 1865. This estimation highlights the importance of the railways development for Argentine growth. In fact, the Argentine ratio of 1.81 per cent between net revenues and GDP in the period resembles the British equivalent figure of 2.52 per cent, and compares favourably with similar nations undergoing railway expansion during this period (Mitchell, 1983). The contribution of railways to economic growth is expressed in a total factor productivity term. This is based on the comparison at the end of the period between the cost of railway transport and traditional pre-railway transport. The estimation relies on the evaluation of direct real income gain from railways derived from the social savings. These results are then expressed as

percentage points once social savings have been converted into additional consumer surplus and increased by railway profits. Argentina's railway freight output of 8,985.4 is significantly larger than other rail oriented countries in 1913 (Herranz-Loncan, 2013). Table 3 below shows the contribution of railways to productivity and growth before 1914.

	Argentina (1865 - 1913)
a) Railway capital stock per capita growth	6.36
b) Railway profits share in national income	1.81
c) Railway capital contribution (a x b)	0.115
d) TFP contribution	.533
e) Total railway contribution (c + d)	.648
f) GDP per capita growth	3
g) Railway contribution as % of GDP growth (e/f)	21.6

Table 2: The Contribution of Railways to Productivity and Growth before 1914

Irish Agriculture

Geary and Stark's paper (2002) aims to evaluate the GDP level of each of the United Kingdom nations between the period 1861 and 1911, and their values are sector specific. The variables they employ are labour force and productivity grouped by sector and by country. Irish employment in agriculture decreased from over 1.2 million in 1861 to approximately 846,000 by 1911. Though this can be explained in part by the declining population, the dynamic in Irish agriculture had changed from labour to land intensive. They then identify sectoral output in the United Kingdom, derived from Feinstein's (1972) index numbers of sectoral output at constant factor cost. Employment in agriculture decreases from over 3.2 million in 1861 to just over 2.2 million by 1911 across Britain, and agricultural output remained rather constant during this period during a time of extensive growth in other industries. This relative slowdown emphasises the need to check for endogeneity bias in the regression as the Argentine rail development could possibly be due to openings in British markets.

By 1908, 58 per cent of the net value of livestock production came from exports out of Ireland. Between 35 to 40 per cent of Irish cattle in the 1850s were exported to Britain. This figure increased to 50 per cent in the 1860s and up to 70 per cent by the end of the nineteenth century (Turner, 2002). Adjustments in the price terms of trade encouraged a big push towards a livestock economy. There was a diminishing size of the domestic Irish market and consequently Irish agriculture was heavily dependent on the British market as seen from Turner's figures. The British economy was a free market and once the issue of livestock product perishability had a solution through improved refrig-

eration technologies and further technological advancements internationally, any protection Irish suppliers received was eroded by new competitors, namely Argentina (Turner, 2002).

Approach

For our research, we recommend running a two-stage regression model. Firstly, we need to establish the effect of railway development on Argentine exports to Britain and for this we must run a multiple linear regression model. It is important to isolate the railway's impact from other technological advancements, namely strides in refrigeration technology and shipping. As we are investigating the effects of technology change, GDP growth per capita may yield more accurate results than simply GDP per capita (Matthews, 1982). This model can be written as follows, with A denoting Argentina and B denoting Britain:

$$\text{ExportAt} = \beta 0 + \beta 1\text{railwayAt} + \beta 2\text{techAt} + \beta 3\text{speedAt} + \beta 4\text{GDP-capgrowthBt} + \beta 5\text{relPBt} + \beta 6\text{tarBt} + \beta 7\text{exzt} + \text{et}$$

Where the explanatory variables are:

Railway = Mileage in Argentina at period t (Mitchell, 1983)
Tech = Increases in trans-Atlantic shipping volumes from refrigeration techniques (Gravil, 1985)
Speed = Trans-Atlantic delivery speed (Gravil, 1985)
GDPcapgrowth = Per capita GDP growth in Britain (Matthews, 1982)
RelP = Relative price of meat across regions (Perren, 1978)
Tar = Tariffs in trade between Argentina and Britain (Gravil, 1985)
Exz = Meat exports of other competing nations to Britain (Perren, 2006)
et = error variable

This regression will determine the influence of railway development on Argentine exports to Britain. The results of this regression exploring railway development influence on exports are important and even without further research they offer useful insights into this topic.

One concern is the endogeneity of the railway development. The development of the Argentine railways could have been in response to price or quantity factors in the British meat market and not vice versa. In order to empirically assess the impact of the development of rural Argentine rail networks in the late nineteenth century on the prices and exports of Irish agricultural produce in Britain we will need an econometric model that takes this endogeneity bias risk into account. An instrumental variable approach would

overcome the issue. Argentine railway miles will be used as an instrument for the exported goods in Britain from Ireland. ExportAt from the earlier regression, being the increase in Argentine exports as a results of the railways will act as the control variable in this case. The instrumental variable model can be written as follows, with I denoting Ireland:

$$\text{ExportIt} = \beta 0 + \beta 1\text{ExportAt} + \beta 2\text{techIt} + \beta 3\text{speedIt} + \beta 4\text{GDPcap-growthBt} + \beta 5\text{relPBt} + \beta 6\text{tarBt} + + \beta 7\text{exzt} + \text{et}$$

Where the explanatory variables are:

Tech = Technology driven increases in exports from Ireland to Britain (Perren, 1978 & Agricultural Statistics of Ireland Journals, 1891, 1901, 1911, 1916)
Speed = Delivery speed (Perren, 1978)
GDPcapgrowth = Per capita GDP growth in Britain (Matthews, 1982)
RelP = Relative price of meat across regions (Perren, 1978)
Tar = Tariffs in trade between Ireland and Britain (Perren, 1978 & Agricultural Statistics of Ireland Journals, 1891, 1901, 1911, 1916)
Exz = Meat exports of other competing nations to Britain (Perren, 2006)
et = error variable

Given the available data this regression can be run every year of the 1857 to 1910 period, leaving 53 data points of analysis. Regression results will be presented without controls and then with controls.

References

Bignon, Esteves and Herranz-Loncan. 2015. Big Push or Big Grab? Railways, Government Activism and export growth in Latin America, 1865-1913. Revista de Historia Económica, 35:2:12-40.

Crotty, R. 1966. Irish agricultural production its volume and structure. Cork University Press: Cork University.

Edelstein. 1984. Overseas Investment in the Age of High Imperialism: The United Kingdom, 1850-1914. Journal of Political Economy, 92:2:334-36.

Fajgelbaum, P. and Redding, S. 2014. External Integration, Structural Transformation and Economic Development: Evidence from Argentina 1870-1914, NBER Working Papers 20217, National Bureau of Economic Research, Inc.

Feinstein, H. 1972. National Income, Expenditure & Output of the United Kingdom, 1855-1965. London: Cambridge University Press.

Ferns, H.S. 1950. Investment and Trade Between Britain and Argentina in the Nineteenth Century. Economic History Review, 3:2:203-18.

Geary, F. and Stark, T. 2002. Examining Ireland's Post-Famine Economic Growth Performance. Royal Economic Society, 112:482:919-35.

Gravil, R. 1985. The Anglo-Argentine Connection, 1900-1939. London: Westview Press.

Herranz-Loncan, R. 2013. Transport Technology & Economic Expansion: The Growth Contribution of Railways in Latin America Pre-1914. Revista de Historia Económica, 32:1:13-45.

Kennedy, L. and Solar, P. 2009. Irish Agriculture: A Price History from the Mid-Eighteenth Century to the Eve of the First World War. The Economic History Review, 62:2:485-86.

Lenz, M. 2005. The Construction of Railroads in Argentina in the Late 19th Century: The Major Role of English Companies. Rio Grande do Sul, 11:3:34-56.

Matthews, R. 1983. British Economic Growth 1856-1973: The Post-War Period in Historical Perspective. London: Oxford Scholarship.

Mitchell, B.R. 1983. International Historical Statistics: The Americas and Australasia. London: Macmillan.

Oliner, S. and Sichel, D. 2002. Information Technology and Productivity: Where Are We Now and Where Are We Going? Federal Reserve Board, 29:3:1-11.

Perren, R. 2006. Taste, Trade and Technology: The Development of the International Meat Industry Since 1840. Ashgate: Ashgate Publishing.

Perren, R. 1978. The Meat Trade in Britain 1840-1914. Agricultural History, 53:3:1-13.

Summerhill, W. 2003. Order Against Progress. Government, Foreign Investment, and Railroads in Brazil, 1854-1913, Stanford: Stanford University Press.

Turner, M. 2002. After the Famine: Irish Agriculture, 1850-1914. London: Cambridge University Press.