Cassidy, Daniel; Hanley, Nick

Working Paper

Union, border effects, and market integration in Britain

EHES Working Paper, No. 228

Provided in Cooperation with:
European Historical Economics Society (EHES)

Suggested Citation: Cassidy, Daniel; Hanley, Nick (2022) : Union, border effects, and market integration in Britain, EHES Working Paper, No. 228, European Historical Economics Society (EHES), s.l.

This Version is available at:
https://hdl.handle.net/10419/298422

European
Historical
Economics
Society

EHES Working Paper | No. 228 | October 2022

Union, border effects, and market integration in Britain

Daniel Cassidy,
University of Galway

Nick Hanley,
University of Glasgow

EHES Working Paper | No. 228 | October 2022

Union, border effects, and market integration in Britain

Daniel Cassidy[1],
University of Galway

Nick Hanley,
University of Glasgow

Abstract

The Act of Union (1707) unified England and Scotland politically and economically, formally establishing the United Kingdom of Great Britain, and a customs union throughout the island of Britain. In this paper, we examine the impact of union on British market integration using wheat prices from a sample of English and Scottish markets. We estimate a coefficient of variation and a dynamic factor model to examine the evolution of price convergence and market efficiency across English and Scottish markets from the 1640s to the mid-eighteenth century. Our results suggest that union strongly influenced price convergence but had little impact on market efficiency. There was an immediate sharp increase in the level of price convergence across British markets following the union, suggesting that the elimination of tariffs and other trade frictions was a strong driver of price convergence. To formally test the impact of union on price convergence, we estimate border effects which show the impact of the pre-union border on price gaps between English and Scottish markets. The results suggest that the customs union strongly influenced price convergence, lowering the average price gap by 16%, and implying a pre-union border width of 160-162km.

JEL Codes: F15, N13, P45

Keywords: Customs Union, Market Integration, Prices

[1]Corresponding Author: Daniel Cassidy, (daniel.cassidy@universityofgalway.ie)

1. Introduction

Recent economic history has shown that customs unions are important drivers of market integration and economic growth. The formation of the European Economic Community, following the Treaty of Rome in 1957, was part of a post-war transition back to open borders and free trade in Europe. A key objective of the treaty was to promote trade and integration among the nations of Europe, ultimately leading to the formation of a customs union and single market. The EU single market offers equal trade terms to all member states of the EU, but imposes a set of common external rules and tariffs on non-member states. The UK's decision to leave the EU and consequently the single market reinstates an economic border between Europe and the UK. This border imposes trade frictions which increase transit times and lead to higher transportation costs. With border checks already in place and uncertainties remaining over the Northern Ireland protocol, it is important to assess the full potential impact of an economic border on the integration of markets.

Classical economic theory suggests that market integration is an important driver of economic growth. Integrated markets promote trade and encourage the specialisation of labour, leading to higher productivity, trade, output, and living standards. Several factors influence the integration of markets from transportation costs, which are a function of geographic distance and transportation technology, to government trade policies. The latter through reducing trade barriers and restrictions can directly influence the process of price convergence, with low or zero tariffs promoting greater trade and price convergence, and high tariffs reducing trade and ultimately leading to price divergence.

In this article, we look to British history to help us understand the effects of economic borders on prices and the integration of markets, and by extension trade and economic growth. One of the world's longest-standing customs unions was formed in May 1707 when the Act of Union bound the nations of England and Scotland politically and economically, formally establishing the Kingdom of Great Britain. The elimination of the border between England and Scotland led to substantial growth in Anglo-Scottish trade, promoting economic growth throughout the island of Britain. We empirically assess the impact of the elimination of the border through an examination of price convergence and market efficiency among English and Scottish markets both before and after the union. To formally estimate the impact of the removal of trade barriers and frictions on price convergence following the union, we estimate border effects which show how the pre-union border affected price gaps between English and Scottish markets.

We use grain prices from 21 British markets, 12 English and 9 Scottish, to derive a coefficient of variation and estimate a dynamic factor model to examine price convergence and market efficiency. To estimate border effects, we use a panel fixed effects difference in difference approach which includes Irish markets that remained outside the union. Including these markets allows us to isolate the border effect from the impacts of infrastructure development and advancements in transportation technology. The rest of this article is structured as follows: Section 2 outlines the theoretical framework of our analysis, the law of one price, and surveys the market integration and border effects literature. Section 3 surveys the historical literature and provides an account of the impact of the Act of Union on the English and Scottish economies and Anglo-Scottish trade. Section 4 presents and describes the data

we use in our empirical analyses. Section 5 examines price convergence and market efficiency in the pre- and post-union years. Section 6 estimates border effects and examines the impact of the border on price gaps between English and Scottish markets, and Section 7 concludes.

2. The law of one price, market integration, and customs unions

Classical economic theory suggests that market integration is an important driver of economic growth. Integrated markets promote trade and encourage the specialisation of labour, allowing regions to exploit comparative advantages and increase productivity, which leads to higher output and living standards. Market integration is typically measured by testing the law of one price, an examination of price differentials across markets. Among highly integrated markets, arbitrage should ensure that the price of a relatively homogeneous commodity is equal when expressed in a common currency. Under such conditions, price differentials typically represent transportation costs between markets, which historically, were strongly influenced by geographical factors such as distance and accessibility, with price trends at coastal settlements served by maritime transport networks likely to be more integrated with external price trends. In less integrated markets, price differentials not only reflect transportation costs, but also the costs of trade barriers and frictions such as protective tariffs, import quotas, currency exchange, and border checks.

Price convergence and market efficiency are widely used metrics throughout the literature to test the law of one price and market integration. Price convergence tests the degree to which prices across a sample of markets converge to a similar level over time, with changes typically reflecting developments in infrastructure, transport technology, or the underlying political and economic relationships between trade partners. Market efficiency examines the degree of correlation between price changes across markets and the speed of price adjustment in response to shocks that cause deviations from the law of one price. Typically, improvements in efficiency are reflective of better infrastructure and communications, enabling faster transportation of commodities and communication of price information between markets.

Market integration has been examined across various markets and time periods. Federico et al. (2021) and Bateman (2011) examine long-run trends in price convergence and market efficiency among European markets from the late medieval period until the First World War and Industrial Revolution respectively. These studies suggest that European markets began to integrate from the late fifteenth century but experienced temporary setbacks due to the impact of large international wars on trade and markets. Despite these setbacks, long-run trends in price convergence and market efficiency show that the level of European market integration has been gradually rising, but with substantial differences in the level of integration at bilateral and intra-national levels (Bateman, 2011).

At a global level, markets became highly integrated from the nineteenth century, with improvements driven by better transportation methods and infrastructure which allowed for a much greater range of goods to be transported over long distances (Findlay, 2003). Railways opened large agricultural regions of North America to global markets and steamships allowed for bulky commodities like grain to be traded across continents (Findlay, 2003; O'Rourke, 1997; Uebele, 2011; Ejrnaes et al., 2008). Better technology had a profound effect on transportation costs, lowering freight rates by 1.5% per annum between 1840 and 1913, and

reducing price gaps between European and US markets (Findlay, 2003). In the late nineteenth century, after several decades of trade liberalisation, governments began to reinstate protectionist policies in response to pressure from European landowners who fared badly from free trade. These policies reduced global price convergence as protective tariffs checked the influence of improved transportation technology on price differentials (Findlay, 2003).

In the twentieth century, political factors played a large role in determining the integration of markets. During the World Wars, the global economy experienced a general shift towards protectionism, however, trade liberalisation quickly became a policy priority in the early post-war years. The General Agreement on Tariffs and Trade (GATT) replaced earlier protectionist policies and began a transition back to free trade at a global level. This move towards open borders accelerated growth between the 1950s and 1980s with world trade and output growing at average annual rates of 6% and 4% respectively (Rivera-Batiz and Xie, 1992). Greater trade following the GATT was accompanied by higher levels of price convergence and market efficiency in global agricultural markets, with faster price adjustment speeds and greater transmission of global price shocks between 1986 and 1998 (Fabiosa, 1999).

In Europe, the EEC was established in 1958 to promote economic integration through the establishment of a customs union and common market. The EU customs union removed trade barriers between member states and operates a common external customs policy. The formation of the single market was complete by 1993 when the union looked to promote deeper integration, adopting common monetary policy through European Monetary Union. Both the customs and monetary unions influenced European market integration with the former removing trade barriers between markets and the latter reducing exchange rate volatility and improving the synchronisation of macroeconomic cycles among member states. While monetary union is important, empirical studies have shown that customs union, and in particular the establishment of the EU single market in 1993, had a relatively greater effect on price convergence throughout Europe during the 1990s than monetary union and the creation of the single currency (Engel and Rogers, 2004).

This broad reading of the historical market integration literature suggests that technological advancements in transportation and the development of infrastructure played an important role in promoting market integration from the early modern period, while the role of governments and trade policy played a more significant role from the mid-nineteenth century. Markets began to liberalise in the mid-nineteenth century as nations established free trade agreements. Free trade led to an increase in the growth rate of exports across Europe from around 1.9% per annum between 1837–1845, to 6.1% between 1845–1859 (Bairoch, 1995). Despite earlier developments, the landmark Cobden-Chevalier trade agreement, which established a free trade agreement between Britain and France, is widely believed to have paved the way for a general shift from protectionism to free trade in Europe from 1860.

The Cobden-Chevalier agreement was a bilateral free trade agreement incorporating a most-favoured-nation clause which effectively passed on tariff reductions to the existing trade partners of Britain and France and led to a subsequent network of bilateral free trade agreements (Bairoch, 1995; O'Rourke and Williamson, 2001). While most accounts suggest that the Cobden-Chevalier agreement had a substantial impact on trade, others question whether it was a catalyst for free trade or built on early movements toward free trade

(Accominotti and Flandreau, 2008; Tena-Junguito et al., 2012; Federico, 2012; Sharp, 2010). The repeal of the British Corn Laws in 1846, and a series of trade agreements signed between continental European nations had preceded the signing of the Cobden-Chevalier agreement. In Germany too, there was a movement to establish not only free trade among the scattering of independent German states but also a customs union.

The creation of the German Zollverein in 1834 unified Prussian and German states in a free trade area and customs union. The German Zollverein was a move towards a comprehensive German economic unification, uniting regional German customs unions which had been formed in the early nineteenth century: the Prussian customs union, the South German customs union, and the Middle German commercial union. Shiue (2005) uses a panel regression model to estimate the border effects of the Zollverein. The findings of this study show that the border between German states accounted for 22-30% of the average price gap between German grain markets, a finding which shows that government trade policies and customs unions were indeed important in the nineteenth century.

While the nineteenth century marks the beginning of widespread government attempts to liberalise markets, we wish to investigate the impact of trade policies and customs unions in an earlier period. The Act of Union of 1707, which created a free trade area and customs union throughout the island of Britain, provides this opportunity. The union has received little direct empirical attention from economists in terms of its effect on the integration of markets, and in this article, we aim to econometrically examine its influence on the integration of British markets. To fully interpret the effect of the union on British markets, it is necessary to not only examine the years immediately surrounding the union but a period stretching from the regal union of England and Scotland in 1603, the Union of Crowns, to the mid-eighteenth century, when historians have argued the long-run gains from the 1707 union began to materialise. In the following section we provide an overview of the Act of Union, focusing on its economic implications, and provide a review of the historical literature on the causes and consequences of union, both of which are necessary to interpret its economic effect.

3. The Union of Crowns and the Union of Parliaments

The Act of Union of 1707 created a unified British state, amalgamating the parliaments of England and Scotland in a joint legislature at Westminster. The Union of Parliaments built on and solidified the regal union of 1603, the Union of Crowns, when King James VI of Scotland inherited the crown of England from his cousin Queen Elizabeth I, creating a diplomatic alliance between England and Scotland and a *de facto* United Kingdom of Great Britain. The Union of Parliaments extended beyond diplomacy, to economic, political, and religious matters, many of which were still determined at a national level throughout the seventeenth century. The union was to promote full economic integration, removing the remaining legislative barriers which had restricted integration in the seventeenth century, by establishing customs and monetary unions throughout the island of Britain, and a level playing field for English and Scottish merchants in foreign trade.

The future macroeconomic relationship between England and Scotland was defined in the union treaty by a set of common rules for customs regulations, monetary units and standards, taxation, and trade. The post-union trade framework was defined in articles four, five, and six

of the treaty. Article four extended to Scotland the right to trade directly with England's colonies, exempting them from the navigation laws which had been in effect throughout the seventeenth century. Article five recognised all Scottish shipping as British and required that they be entered into the general register of trading ships belonging to Great Britain. Article six created a customs union between England and Scotland, providing an equal footing for English and Scottish merchants in trade through equalisation of all prohibitions, restrictions, and regulations governing exports and imports; ''That all parts of the United Kingdom for ever from and after the Union shall have the same Allowances, Encouragements and Drawbacks, and be under the same Prohibitions, Restrictions and Regulations of Trade and lyable to the same Customs and Duties on Import and Export''. Monetary union was established by article sixteen, through the assimilation of the Scottish pound into the pound sterling at a rate of twelve to one in favour of sterling.

For England, union with Scotland was desirable from a political perspective. For centuries after the Scottish wars of independence, Scotland had been allied with England's continental rival, France, and together they invaded England in the early thirteenth century. This alliance caused unease in England, as it left its northern flank vulnerable to foreign invasions. Union was more important for Scotland economically, however, it brought economic gains for England too. The settlement of the border region between England and Scotland encouraged greater flows of trade and commerce between both countries after centuries of conflict had restricted the growth of trade and economic growth more generally in the border region. The union also ensured the supply of Scottish agricultural commodities such as grain and cattle, on which England became increasingly dependent as the eighteenth century progressed, bringing with it population growth and industrialisation, and a consequent need for a greater food supply.

Economic historians including R.H. Campbell, T.M. Devine, T.C. Smout, and C.A. Whatley have examined the impact of the 1707 union on Scottish trade and economic development (Campbell, 1964; Devine, 2008; Smout, 1964; Whatley, 1989). These accounts suggest that the union had a positive long-run impact on the Scottish economy, but its short-run impacts differed by sector. To fully understand the impact of the 1707 union on Scotland, it is necessary to distinguish between these long and short-run impacts and look at the development of the Scottish economy and overseas trade in the seventeenth century. Scottish trade became increasingly dependent on English markets as the seventeenth century progressed as new protectionist policies on the continent reduced Scottish trade with Europe. Given these trends in external trade, a potential economic backlash from England in the event of a Scottish vote against a parliamentary union could have drastically reduced the long-run growth potential of the Scottish economy.

Smout (1964) examined the causes of the union, beginning with an account of Scottish economic development from the thirteenth century, when Scotland regained independence after a period of English occupation from 1296–1313. Following independence, poor relations with England and alliance with France helped to shape the geographical orientation of Scottish external trade. The Scottish economy developed free from dependence on English markets as Scottish trade developed with Baltic and continental countries including Norway, France, the Low Countries, and Spain, with Anglo-Scottish trade of little significance to overall Scottish external trade. The goods exported by Scotland in this period, wool, skins, hides, fish,

and plaid, reflected the agricultural structure of its economy, while imports typically consisted of luxuries such as wine, salt, groceries, wood, iron, and flax. Like other regions, Scotland produced and consumed grains domestically, but in years of harvest failure and famine, imported grain, particularly from the Baltic states, to ease the effects of shortages.

In 1603, the Union of Crowns established a regal and diplomatic union between England and Scotland, but economic barriers remained between both countries. This union effectively bound Scotland to English foreign policy and involved Scotland in a series of English conflicts with its traditional continental trade partners. This alliance led to a substantial change in Scotland's external trade patterns, with continental trade falling in favour of trade with England. While the regal union partially determined Scotland's trade partners, it was not entirely responsible as British trends in domestic demand and foreign trade policies were too influential. The rise of Anglo-Scottish trade was aided by an extension of governance and law to the border region which allowed for the safe passage of merchants and goods through the region, increasing English demand for Scottish agricultural exports. The decline in Scottish trade with the continent and the Baltic was affected by a change in foreign trade policy, with protective duties and import restrictions in France, Norway, and the Low Countries, accelerating the shift in Scottish export patterns from continental markets to English markets (Smout, 1964).

Anglo-Scottish trade increased in the decades after regal union. Scotland exported a range of goods to England including salt, cattle, linen cloth and yarn, coal, grain, and skins, and in return imported English consumer goods. The 1603 union substantially increased the flow of Scottish agricultural commodities south of the border, which encouraged the adoption of improvement methods in Scottish agriculture. Land enclosures increased productivity and gradually shifted the population from rural subsistence living to early industrial employment in Scottish towns and cities. Regional agricultural specialisation increased as the fertile eastern regions of Scotland specialised in grain production, the Highlands in cattle rearing, and the Borders in the rearing of cattle and sheep (Devine, 2000; Saville and Auerbach, 2006; Gibson and Smout, 1995b). Cattle rapidly became one of Scotland’s chief exports as the quantity driven to English markets increased substantially over the seventeenth century, reaching 40.2% of total Scottish exports to England by 1703. Further growth in cattle exports was achieved throughout the eighteenth and early nineteenth centuries, as Scottish cattle exports continued to grow in volume until the end of the Napoleonic Wars (Smout, 1964; Whatley, 1989).

After nearly a century, the growth of Scottish external trade began to slow in the late 1670s (Smout, 1964; Whatley, 1989). The main cause of this decline was a deterioration of political and economic relations with England. England, concerned about the competitiveness of sectors of its economy, began to impose tariffs on Scottish imports. These tariffs compounded the difficulties Scotland faced in foreign markets arising from continental protectionist policies, and restrictions on direct trade between Scotland and England's colonies arising from the navigation laws. Tensions continued to rise in the final decade of the seventeenth century, and by the end of the 1690s the Scottish economy was in sharp decline as trade restrictions, seven successive years of harvest failure, and the failure of the Darien scheme left the exchequer close to bankruptcy (Cullen, 2010; Smout, 1964).

Difficult economic conditions in Scotland reduced the popularity of the regal union with England, and the Scottish parliament responded by passing two controversial acts which threatened the union: the Act of Security and Succession, and the Act of Peace and War. The first act, issued in 1703, debarred Hanoverian succession unless Scottish interests were severed from English and other foreign influences. The second, issued in 1704, demanded the consent of the Scottish Parliament in waging war and drawing up treaties (Smout, 1964). These acts caused alarm at Westminster and suspecting that some in the Scottish parliament wanted a complete separation, the English parliament responded with the Alien Act of 1705. This Act threatened, that unless commissioners were appointed to discuss full union with England, all Scottish people in England would be treated as aliens, Scottish estates south of the border would be confiscated, and Scottish exports of cattle, coal, and linen would be banned from English markets (Smout, 1964).

The Scots were divided on the issue of parliamentary union with England, but the uncertain economic climate and the potential consequences of the Alien Act persuaded many that union was best. Unionists used economic arguments to gain support, highlighting the importance of English markets for Scottish exports, and the potential consequences of the loss of these markets for the cattle and linen trades. They also stressed the opportunities which union would bring, including the opening of English and colonial markets through free trade, the positive impact of this on the balance of payments, and the flow of English capital to Scottish industry. Those opposed to union argued that maintaining independence would allow Scottish industry to develop free from English competition and that continental trade could be promoted through quality improvements in linen production and a reorganisation of agriculture (Smout, 1964).

On January 6th, 1707, the Scottish parliament voted 110 to 69 in favour of union with England. For England, the union secured peace on the island of Britain and the Hanoverian succession as monarchs of Great Britain. These conditions were necessary for England to maintain and expand, as it did throughout the eighteenth and nineteenth centuries, a global empire, which had a large impact on trade and domestic economic growth. The union too secured Scottish food imports for England, which were used to support a rapidly growing urban population and widespread industrialisation. For Scotland, the effects of the union have been more widely debated. The long-run impact of the union was positive for Scotland. However, the short-run impact of the union differed by sector, with some agents winning and others losing out to intense English competition.

Agriculture was among the sectors of the Scottish economy which benefitted from the union in the short run. The opening up of English markets increased productivity by discouraging small agricultural holdings and bringing more land under regular cultivation (Devine, 2000; Whatley, 1989). The growth of agricultural exports also led to a general increase in Scottish agricultural prices in the post-union years. Scottish grain prices increased significantly, as exports, driven by English demand, doubled to over 57 thousand quarters between 1707–1712 (Mitchison, 1965; Whatley, 1989). Cattle prices rose too, with the number of cattle driven south increasing from around 30 thousand in 1707 to 80 thousand by mid-century (Whatley, 1989). Difficulties emerged in other sectors following the union. In the wool and linen industries, new duties after 1707 severely reduced exports as Scottish interests were sacrificed in favour of English interests in the sector. Other small industries like paper and

candle making were also affected as output and trade declined in the response to strong English competition.

The long-run gains of the union began to materialise from around 1740. The exemption of Scotland from the navigation laws allowed Scottish merchants to trade directly with England's colonies. Along with the growth in agricultural exports, this contributed to a general expansion of Scottish exports in the eighteenth century and the development of Scottish mercantile networks. Scottish merchants, through their trade in the Americas, established Scotland, and in particular Glasgow, as a key European re-export centre in the tobacco trade. Greater external trade increased the income of the Scottish nobility who invested in urban development and industry in Scottish towns and cities, increasing employment and living standards across the country. English capital and the growing wealth of the Scottish nobility and mercantile classes were later channelled into early industries of the Industrial Revolution, setting Scotland on the path to industrial growth in the nineteenth century.

4. **Data**

To examine British market integration, we use annual wheat prices for a sample of English and Scottish markets from 1628–1760. Due to the survival of an abundance of European grain price records from the late medieval period, wheat markets are frequently used to test historical market integration trends. Empirically, wheat prices are desirable as the high frequency of the surviving records, and the extensive market coverage, allow for robust tests of market integration across large samples. From a theoretical perspective, wheat is also a particularly suitable commodity to test market integration. The homogenous nature of the commodity means that quality differentials are unlikely to significantly affect results as might be the case in other agricultural markets such as livestock. Wheat was also widely traded between regions and more suitable for analysing cross-border trends in price convergence and market efficiency than lesser traded goods.

We use English wheat prices from Federico et al. (2021), which includes wheat price data from the thirteenth century until the First World War.[1] For Scotland, our wheat price data is from Gibson and Smout's price history of Scotland, which lists Scottish grain prices from the early seventeenth century until 1780 (Gibson and Smut, 1995a). In total, our data covers twelve English markets and nine Scottish markets, including Cambridge, Exeter, Lincoln, London, Maidstone, Newcastle, Oxford, Portsmouth, Shrewsbury, Winchester, Windsor Eton, York, Aberdeen, Edinburgh, Fife, Haddington, Linlithgow, Perth, Ayr, Berwick, and Stirling. We convert English prices from silver per hectolitre to sterling per bushel using sterling exchange rates with silver from the Allen-Unger database on the basis that a hectolitre is the equivalent of 0.36 imperial bushels (Allen and Unger, 2019).[2] We convert Scottish wheat prices from Scots pound per boll, a local Scottish measure equal to 4.07 imperial bushels, to sterling per imperial bushel using the par exchange between sterling and the Scots pound of twelve Scots pounds per pound sterling. All prices, expressed in sterling per imperial bushel, are presented in Figure 1.

[1] Personal communication by G. Federico.
[2] See http://www.gcpdb.info/data.html

Figure 1 suggests that price convergence in Britain was much stronger in the post-union years relative to the pre-union years. From the beginning of the eighteenth century, price trends across markets closely reflected each other with the degree of correlation increasing strongly from 1720. In the seventeenth century, prices varied more intensely with crisis years marked by large swings in prices. This was clear in the 1640s and 1650s when the civil war and Cromwellian invasion of Scotland caused significant increases in wheat prices which were followed by sharp declines in the 1660s. The 1690s again saw large and persistent price increases across British markets in response to famine in Scotland and other regions of Europe and greater price volatility in food markets during the Nine Years War.

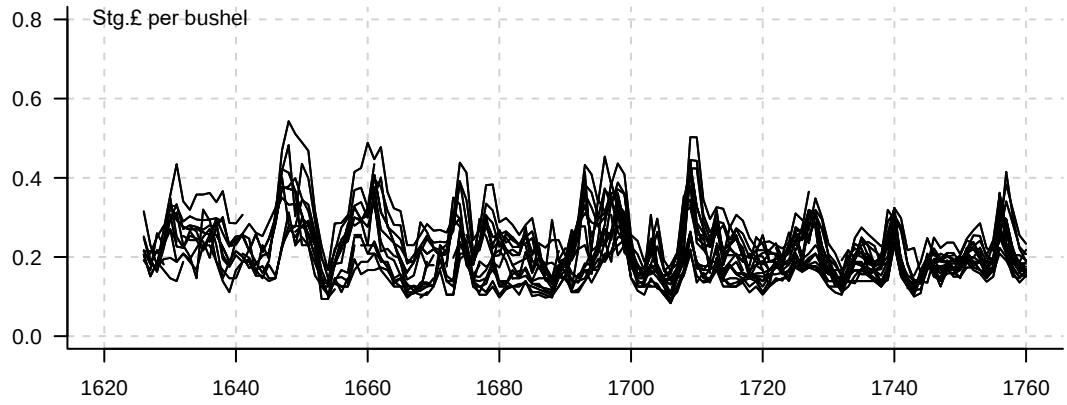

Figure 1: British wheat prices 1626–1760

Overall, the level and volatility of British wheat prices fell in the post-union years and prices appear to have converged strongly, particularly after 1720. However, some extreme events appear to have caused common shocks across British markets. Prices were notably volatile following the winter of 1709, which was referred to as the Great Frost in England. Harvest failures following these extreme weather conditions, along with wartime pressures, caused economic crises in Britain and other parts of Europe around 1710 (Pain, 2009; Ó Gráda and Chevet, 2002). Famine conditions in 1740 and the impact of war on markets in the late 1750s were again correlated with large price swings, however, the severity of these swings appears to be much lower than comparable movements in the seventeenth century, potentially reflecting better domestic market integration in Britain.

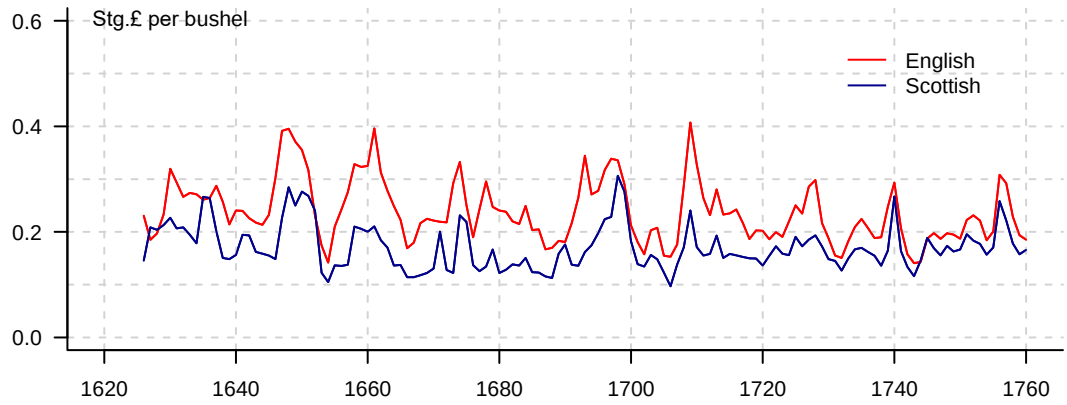

Figure 2: Wheat prices (national averages) 1626–1760

In Figure 2, we plot national averages of both English and Scottish wheat prices based on our sample of markets. National averages can help to identify overall long-run market integration trends. In both the pre- and post-union years there was a substantial difference between the English and Scottish national averages, with the price of wheat typically higher in England. As shown in Table 1, this price differential averaged around £0.07 sterling per bushel for the full sample period but differed in terms of the average level and volatility in the pre- and post-union years. Before the union, the average national price gap was at £0.08 sterling per bushel but fell to £0.05 sterling in the post-union years. The price gap gradually closed in the decades following the union, with prices reaching close to unity around 1740, and maintaining only a slight differential in the years after this, suggesting that the union had a strong impact on long-run price convergence.

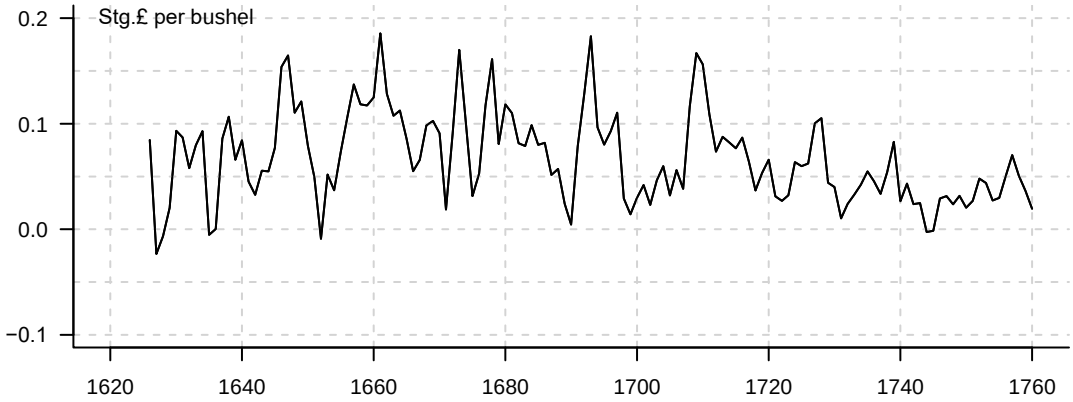

Figure 3: Price gap 1626–1760

The statistics presented in Table 1 also show the impact of the union on the variance of British wheat prices. The standard deviation of both the English and Scottish national average wheat price fell from 6% and 5% respectively in the pre-union period, to 5% and 3% in the post-union period, hinting at improved market efficiency in post-union Britain. The standard deviation of the price gap between these national averages also fell from 5% to 3% after the union, again potentially pointing to greater market efficiency after the union. To formally test trends in price convergence and market efficiency, in the next section we calculate a coefficient of variation across British wheat markets and derive a dynamic factor model to test market efficiency and the emergence of a British reference price in wheat markets.

Table 1: Wheat price summary statistics

	Mean	Minimum	Maximum	Standard deviation
Full sample				
English national average	0.24	0.14	0.41	0.058
Scottish national average	0.17	0.10	0.31	0.042
Price gap	0.07	-0.02	0.19	0.043
Pre-Union				
English national average	0.25	0.14	0.40	0.060
Scottish national average	0.17	0.10	0.31	0.049
Price gap	0.08	-0.02	0.19	0.045
Post-Union				
English national average	0.22	0.14	0.41	0.050
Scottish national average	0.17	0.12	0.27	0.028
Price gap	0.05	0.00	0.17	0.034

5. Price convergence and market efficiency before and after the union

The coefficient of variation is a widely used measure of price convergence in the market integration literature (Cassidy and Hanley, 2022; Chilosi et al., 2013; Federico, 2011; Federico et al., 2021; Jacks, 2004; Gibson and Smout, 1995b). The coefficient of variation is easy to calculate, comparable across time and space for the same product, and robust to quality differentials for homogenous products such as wheat (Federico et al., 2021). The coefficient of variation is calculated by dividing the standard deviation of market prices across our sample by the sample mean.

$$\frac{\sqrt{\sum \frac{(x_i - \bar{x})^2}{n}}}{\bar{x}} \quad (1)$$

We calculate the coefficient of variation across our sample of English and Scottish markets from 1646–1760. In Figure 4, we present the coefficient of variation for these markets along with a 20-year moving average to distinguish short-run variations from long-run trends in price convergence. The results show that in the seventeenth century English and Scottish markets had achieved relatively high levels of price convergence but suffered a setback in the latter decades of the seventeenth century. Both the coefficient of variation and its long-run trend, as shown by the 20-year moving average, begin to increase from the 1660s, signalling a decline in price convergence. This finding shows that the decline in English and Scottish relations in the late seventeenth century, as outlined in Section 3, had a significant impact on price integration. This result suggests that the potentially more extreme economic dislocation resulting from a Scottish vote against union could have been very damaging for Scottish external trade and market integration, and by extension the long-run growth potential of the Scottish economy.

The union of 1707 appears to have had a major influence in reversing this trend and further deepening the level of price convergence. From 1707, the coefficient of variation shows a level decrease, reflecting the fundamental changes in the economic relationship between England and Scotland in the post-union period. The long-run moving average trend too gained significant downward momentum from the time of the union until 1760, indicating that the union was responsible for a sharp increase in price convergence triggered by the removal of tariffs and other trade frictions, and was a catalyst for long-run British price convergence.

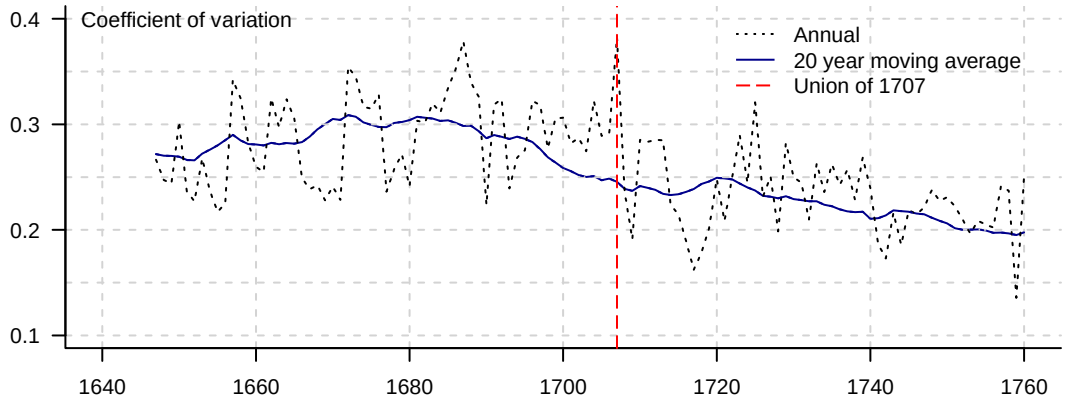

Figure 4: Coefficient of variation (wheat prices) 1626–1760

Market efficiency can be measured using several econometric techniques. Many studies have used cointegration and autoregressive models to examine the speed of price adjustment in response to shocks that cause prices to deviate from the law of one price. As outlined by

Federico et al. (2021) and Brunt and Cannon (2014), these approaches require that the data frequency exceeds the average adjustment time, which was likely less than a year, and therefore raise questions regarding the interpretability of results generated using annual data. They also impose restrictions, assuming that merchants were mainly aware of price movements at domestic and foreign markets in which they traded. Federico et al. (2021) argue that this ignores the reality that merchants and traders adjusted their prices based on expectations of harvest outcomes and multilateral price movements.

Federico et al. (2021) use a dynamic factor model to estimate European market efficiency, which avoids the problems outlined above. In this model, price changes are regressed on a common latent factor and an idiosyncratic error term. The common latent factor is representative of the influence of European multilateral market conditions on prices and is the equivalent of a modern reference price, such as Brent or WTI in oil markets. The idiosyncratic error term is representative of market-specific conditions which affect local prices. Using this approach, the variance of price changes at each market can be decomposed to examine the influence of common market conditions or shocks on local prices relative to the influence of local conditions, with a rise in the covariance of the common factor and price changes at each market signalling an increase in market efficiency.

We follow this approach to test for market efficiency among British wheat markets from 1646–1760. We regress the first differenced values of British wheat prices on a common British factor and a set of time-varying market-specific residuals.

$$\Delta Pw_{it} = \lambda_i C_t + \mu_{it} \tag{2}$$

Where ΔPw_{it} is the change in the price of wheat at market i at time t, C_t is the British shock component common to all markets, λ_i is the loading factor (coefficient) of the i^{th} market on the common factor, and μ_{it} are the time-varying and market-specific residuals. $\lambda_i C_t$ measures the contribution of common shocks to changes in prices at each market at time t. Therefore, the degree of co-movement between the common British factor and prices changes at each individual market can be measured through a decomposition of the variance of price changes at each market, accounting for variation caused by common British shocks and market-specific factors

$$\tau_i = \lambda_i^2 * var(C_t)/var(\Delta Pw_{it}) \tag{3}$$

To establish an overall measure of British market efficiency, τ, we take the average value of τ_i across all markets and calculate a 20-year moving average to examine the long-run trend in British market efficiency and the emergence of a British reference price. We conduct this exercise for two sub-periods, calculating loading factors for the pre-union period and the post-union period, allowing us to examine the impact of union on market efficiency arising from the likely increase of the loading factors for each individual market on the common British factor in the post-union period.

The results of our market efficiency tests are presented in Figure 5. We test the moving average value of τ for structural change using the Bai Perron test for multiple structural

breakpoints (Bai and Perron, 1998, 2003). The results of our breakpoint analysis reveal three breaks in the long-run trend of British market efficiency in 1673, 1698, and 1725. These breakpoints and the corresponding trends are easily explained by the historical accounts of Anglo–Scottish relations over the seventeenth and early eighteenth centuries outlined in Section 3. The break in 1673 shows that market efficiency declined between 1673–1698, following a general decline in Anglo-Scottish trade due to political tensions between Edinburgh and London. The union of 1707 appears to have influenced the recovery of efficiency from 1698–1725, although only modest gains were made in this period, restoring the overall level of efficiency to levels previously attained in the early seventeenth century following the Union of Crowns.

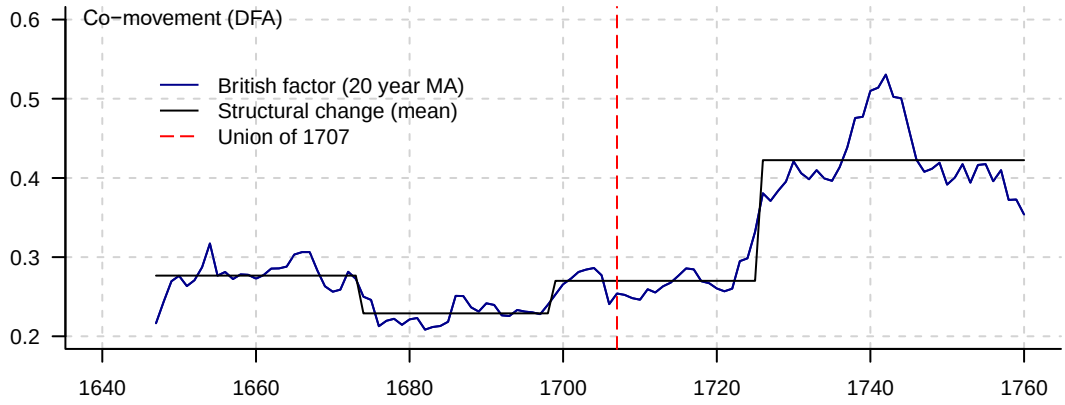

Figure 5: British common factor 1640–1760

British market efficiency increased substantially from 1725, suggesting that the gains of union either took some time to materialise, or that other factors were responsible. This may well have been the case as communications and infrastructure are important determinants of market efficiency. Newspaper circulations, which typically reported commodity prices, increased across Britain in the eighteenth century, with the number of publications in circulation by mid-century far exceeding the number in 1700. The expansion of inland transportation infrastructures including canals and roads may also have been a more important factor for market efficiency than the union itself. Scotland's infrastructure was expanded in the eighteenth century with the expansion of drove roads and the construction of military roads in the wake of the Jacobite rebellions of the eighteenth century. This infrastructure may have been important in enabling merchants and traders to effectively exploit arbitrage opportunities and close price gaps when they emerged. In support of this, our dynamic factor model suggests that the market loading factors measuring the covariance between the common British factor, τ, and local market price changes, increased mainly at Aberdeen after the union, which was one of Scotland's main arable regions and grain export centres.

The results of these tests of price convergence and market efficiency show that the union of 1707 had a large influence on price convergence but had little effect on market efficiency.

This suggests that the main influence of the union was a reduction of tariffs between English and Scottish markets, which caused prices to converge by a margin that likely reflects the tariff rates on goods traded across the pre-union border. To examine this in more detail, we derive the border effects of the British customs union of 1707 in the next section.

6. Border effects: the customs union of 1707

Borders typically increase international price dispersion as trade costs and frictions such as tariffs, import quotas, currency exchange, and border checks cause prices to deviate from the law of one price. Customs and monetary unions effectively eliminate economic borders between nations and lower the cost of trade, leading to greater levels of market integration. The impact of international borders on trade has been assessed for both contemporary and historical examples (Engel and Rogers, 1996; McCallum, 1995; Shiue, 2005). These studies typically measure the impact of economic borders on price gaps for a similar good between two markets separated by a national boundary. In many studies, the border effect is expressed both in terms of the price gap and distance, with the latter typically expressed as the distance equivalent in terms of domestic trade and referred to as the width of the border.

McCallum (1995) examined the impact of borders in North America. Using a gravity model, he estimated that in the absence of customs borders, trade between Quebec and California could be ten times higher than domestic trade between Quebec and British Columbia. Engel and Rogers (1996) also estimate US-Canadian border effects. They show that trade between neighbouring cities separated by the border was equal to domestic US trade between Boston and Houston in terms of price dispersion and trade costs, implying a border effect distance equivalent of 2,848 km. These studies suggest that even among countries with common culture and language, similar legal systems and market structures, border effects can still cause a substantial degree of price dispersion and limit the expansion of trade. Others have estimated larger border effects for countries with lower levels of cultural integration and who are separated by a greater distance such as the US and Japan (Parsley and Wei, 2001).

Shiue (2005) has estimated border effects for the German Zollverein customs union of the nineteenth century. This study uses grain prices to estimate the impact of the elimination of borders between German states on price integration by examining price gaps across pairs of markets. This study estimates Zollverein border effects ranging from 22-30%, indicating the average margin by which Zollverein membership lowered price gaps between its members. Shiue used a difference in difference panel model, regressing the price gap between each market pair on the distance between both markets, and a dummy variable which takes a value of zero when a customs border exists and one when it is eliminated. The inclusion of markets from outside the Zollverein union in the estimation ensures that other factors, such as infrastructure developments and transport technology advancements, were not responsible for lowering price gaps.

We follow the approach of Shiue (2005) to estimate the border effect of the British customs union of 1707. Using data from 1680–1720, we regress the price gap between each market pair on the distance (as the crow flies) between both markets, a dummy border variable that takes a value of 0 when a customs border exists and 1 when it is eliminated, and a bilateral country pair specific effect. This means that for each English-English and Scottish-Scottish

market pair, the border variable is always equal to 1, but for English-Scottish pairs, takes a value of 0 until 1706, and 1 thereafter.[3]

$$lnpg_{ijt} = \alpha_{c,c'} + \beta lndist_{ij} + \delta border_{ijt} + \eta_{ijt} \quad (4)$$

Where $lnpg_{ijt}$ is the log of the price gap between markets i and j at time t, $\alpha_{c,c'}$ is a bilateral country pair specific effect, $lndist_{ij}$ is the log of the distance between markets i and j measured in hundreds of kilometres, and $border_{ijt}$ is a dummy variable which takes a value of 0 when a customs border exists between markets i and j, and 1 when it is eliminated, and η_{ijt} is a mean-zero but possibly heteroskedastic error.

As discussed in Section 2, there are many factors beyond economic borders that can influence price gaps between markets. Infrastructure and transport technology advancements in the early modern period significantly reduced the cost of transporting commodities between markets. Therefore, to ensure that the border variable in equation 4 is accurately accounting for a border effect and no other factors, we run a second regression which includes Irish markets. Ireland, although a client kingdom of the British Crown was not affected by the Act of Union of 1707 and remained outside the British customs union. Ireland maintained a separate parliament in the seventeenth and eighteenth centuries, and Irish trade with Britain was subject to tariffs and restrictions, including the Cattle and Navigation Acts, until Ireland was fully incorporated into the United Kingdom in 1801 (Cullen, 1968, 1987).

Table 2: Border effects regression results

Dependent variable: *ln* Price Gap		
Regression specification	British markets	British and Irish markets
Constant	-3.812***	-3.701***
ln Distance	0.271***	0.241***
Border	-0.159***	-0.158***
Number of observations	1807	2597
Implied border width (km)	160	162

Our border effects regression results are presented in Table 2. The border coefficient in specification 1 measures the change in the average price gap between English and Scottish markets as a result of the customs union of 1707. In specification 2, we include Irish markets and therefore the border coefficient measures both the change in the average price gap between British markets from 1707 relative to the pre-union period, and relative to Irish markets for the entire sample period. In both specifications, the results are similar which reassures us that the border variable is capturing the impact of the elimination of the customs border, and is not influenced by infrastructure developments and transport technology advancements.

[3] In a separate regression, we also include Irish markets that remained outside the customs union of 1707. This allows us to test that the border variable is solely accounting for the impact of the elimination of the border and not the impact of infrastructure developments and transport technology advancements. In the second specification, the border variable between English and Irish markets, and Scottish and Irish markets is equal to 0 in all years.

The border variable is significant in both specifications and suggests that the removal of the customs border led to a 16% fall in the average price gap between English and Scottish markets. As expected, the results also suggest that distance was a significant factor, indicating that a 1% increase in distance led to an increase in the average price gap of between 0.24-0.27%. As mentioned above, border effects are often expressed as a distance equivalent in terms of domestic trade (Shiue, 2005). As distance is measured in hundreds of kilometres, the implied domestic trade distance equivalent or border width is 160km using a sample of British markets only, and 162km using a sample comprised of British and Irish markets.[4]

Shiue (2005) estimates that the width of German borders in 1834 and 1836 was 156km and 149km respectively, while Engel and Rogers (1996) estimate a border width of 2865km for the US-Canadian of the late twentieth century. Measuring border effects in terms of distance can be useful but also raises questions about the comparability of border effects across different regions and time periods. Britain is considerably smaller than Germany and therefore one might expect a British border effect in terms of distance to be smaller if measured at the same point in time. Border effects however are typically not comparable across time because, as pointed out earlier, infrastructure developments and transport technology advancements also reduce price gaps. Expressing border effects as a percentage of the price gap is a more comparable measure across regions and over time. The coefficient on the border variable gives us the estimated border effect in terms of the price gap. We estimate this to be around 16%, which compares to 29.7% and 22.4% respectively for the 1834 and 1837 Zollverein expansion rounds, and 32.4% between the US and Canada in the late twentieth century (Shiue, 2005; Engel and Rogers, 1996).

Overall, our results suggest that on average distance and the pre-union border combined accounted for a little under half of the total price gap between British markets from 1680–1720. While this seems low, it may support some of our earlier findings on British market efficiency. The level of market efficiency among British markets did not increase substantially until the 1720s, which may suggest that slower communications and limited infrastructure played a role in segmenting markets in the seventeenth and early eighteenth centuries. The expansion of the commercial press and the construction of roads and canals in the eighteenth century likely led to an increase in market efficiency as the time taken to communicate price information and transport commodities fell, increasing the effectiveness of arbitrage.

7. Conclusion

In this article, we examined the impact of political union on British market integration. A key question of this paper was the extent to which the 1707 Act of Union affected the integration of English and Scottish markets. To answer this question we tested for price convergence and market efficiency from 1628–1760, allowing us to examine the level of integration both

[4] Using the estimated coefficients for the border and distance variables in regression 1 (0.159 and 0.271 respectively), the implied border effect in terms of distance is the distance that solves 0.159=0.271 x *ln* distance. Engel and Rogers (1996) and Shiue (2005) recommend using the upper 95% confidence interval estimate for distance given the concavity of the natural log function. The upper 95% estimates for distance in specification 1 is 0.337 and specification 2 is 0.326.

before and after the union. Our results suggest that price convergence increased substantially in the decades following the 1603 Union of Crowns, but fell in the latter decades of the seventeenth century due to a decline in political relations and trade between England and Scotland. The level of price convergence recovered strongly and accelerated directly after the Union of Parliaments of 1707. Seventeenth-century market efficiency patterns were similar to trends in price convergence, however, the union of 1707 had no clear short-run effect on British market efficiency. This suggests that other factors such as communications and infrastructure developments may have been responsible for higher levels of efficiency from the mid-eighteenth century.

Overall, these results suggest that the union of 1707 was responsible for an immediate sharp increase in price convergence but had little impact on market efficiency. These results likely reflect the influence of tariffs and other restrictions, which come with national boundaries, on market integration and trade. To establish the degree to which the border affected market integration, we derive border effects which show how the elimination of the border in 1707 affected the average price gap between English and Scottish markets. The results suggest that the customs union caused significant price convergence, lowering the average price gap between English and Scottish markets by 16% and implying a pre-union border width of 160-162km.

References

Accominotti, O. and Flandreau, M. (2008). Bilateral treaties and the most-favored-nation clause: the myth of trade liberalization in the nineteenth century. *World Politics*, 60(2):147–188.

Allen, R. and Unger, R. (2019). The Allen-Unger global commodity prices database. *Research Data Journal for the Humanities and Social Sciences*, pp. 1–21.

Bai, J. and Perron, P. (1998). Estimating and testing linear models with multiple structural changes. *Econometrica*, 66(1):47–78.

Bai, J. and Perron, P. (2003). Computation and analysis of multiple structural change models. *Journal of Applied Econometrics*, 18(1):1–22.

Bairoch, P. (1995). *Economics and world history: myths and paradoxes*. University of Chicago Press.

Bateman, V. N. (2011). The evolution of markets in early modern Europe, 1350–1800: a study of wheat prices. *Economic History Review*, 64(2):447–471.

Brunt, L. and Cannon, E. (2014). Measuring integration in the English wheat market, 1770–1820: new methods, new answers. *Explorations in economic history*, 52:111–130.

Campbell, R. (1964). The Anglo-Scottish Union of 1707. II. The economic consequences. *Economic History Review*, 16(3):468–477.

Cassidy, D. and Hanley, N. (2022). Price convergence and market efficiency in early modern Scotland. *Journal of Scottish Historical Studies*, 42(2):149–174 (forthcoming).

Chilosi, D., Murphy, T. E., Studer, R., and Coskun, T. A. (2013). Europe's many integrations: geography and grain markets, 1620–1913. *Explorations in Economic History*, 50(1):46–68.

Cullen, K. (2010). *Famine in Scotland-the 'Ill Years' of the 1690s*. Edinburgh University Press.

Cullen, L. M. (1968). *Anglo-Irish Trade, 1660-1800*. Manchester University Press, Manchester.

Cullen, L. M. (1987). *An economic history of Ireland since 1660*. B.T. Batsford Ltd., London.

Devine, T. M. (2000). Scotland. In Clark, P., (ed.), *The Cambridge Urban History of Britain*, Vol. 2, pp. 151–164. Cambridge University Press.

Devine, T. M. (2008). *Scotland and the Union 1707-2007*. Edinburgh University Press.

Ejrnaes, M., Persson, K. G., and Rich, S. (2008). Feeding the British: convergence and market efficiency in the nineteenth-century grain trade. *Economic History Review*, 61:140– 171.

Engel, C. and Rogers, J. H. (1996). How wide is the border? *American Economic Review*, pages 1112–1125.

Engel, C. and Rogers, J. H. (2004). European product market integration after the euro. *Economic Policy*, 19(39):348–384.

Fabiosa, J. F. (1999). Institutional impact of GATT: An examination of market integration and efficiency in the world beef and wheat market under the GATT regime. Center for Agricultural and Rural Development (CARD), Iowa State University, Working Paper 99-WP 218.

Federico, G. (2011). When did European markets integrate? *European Review of Economic History,* 15(1):93–126.

Federico, G. (2012). The Corn Laws in continental perspective. *European Review of Economic History*, 16(2):166–187.

Federico, G., Schulze, M.-S., and Volckart, O. (2021). European goods market integration in the very long run: From the Black Death to the First World War. *Journal of Economic History*, 81(1):276–308.

Findlay, R. and O'Rourke, K. H. (2003). Commodity market integration, 1500-2000. In Bordo, M. D., Taylor, A. M., and Williamson, J. G., (eds.), *Globalization in historical perspective*, pp. 13–64. University of Chicago Press, Chicago.

Gibson, A. J. and Smout, T. C. (1995a). *Prices, food and wages in Scotland, 1550-1780*. Cambridge University Press, Cambridge.

Gibson, A. J. and Smout, T. C. (1995b). Regional prices and market regions: the evolution of the early modern Scottish grain market. *Economic History Review*, 48(2):258–282.

Ó Gráda, C. and Chevet, J.M. (2002). Famine and market in Ancien Régime France. *Journal of Economic History*, 62(3):706–733.

Jacks, D. S. (2004). Market integration in the North and Baltic seas, 1500-1800. *Journal of European Economic History*, 33(3):285–329.

McCallum, J. (1995). National borders matter: Canada-US regional trade patterns. *American Economic Review*, 85(3):615–623.

Mitchison, R. (1965). The movements of Scottish corn prices in the seventeenth and eighteenth centuries. *Economic History Review*, 18(2):278–291.

O'Rourke, K. H. (1997). The European grain invasion, 1870–1913. *Journal of Economic History*, 57(4):775–801.

O'Rourke, K. H. and Williamson, J. G. (2001). *Globalization and history: the evolution of a nineteenth-century Atlantic economy*. MIT press.

Pain, S. (2009). The year that Europe froze solid. *New Scientist*, 201(2694):46–47.

Parsley, D. C. and Wei, S.-J. (2001). Explaining the border effect: the role of exchange rate variability, shipping costs, and geography. *Journal of International Economics*, 55(1):87–105.

Rivera-Batiz, L. A. and Xie, D. (1992). GATT, Trade, and Growth. *American Economic Review*, 82(2):422–427.

Saville, R. and Auerbach, P. (2006). Education and social capital in the development of Scotland to 1750. Prepared for the Economic History Society Annual Conference, University of Reading.

Sharp, P. (2010). '1846 and All That': the rise and fall of British wheat protection in the nineteenth century. *Agricultural History Review*, 58(1):76–94.

Shiue, C. H. (2005). From political fragmentation towards a customs union: Border effects of the German Zollverein, 1815 to 1855. *European Review of Economic History*, 9(2):129– 162.

Smout, T. C. (1964). The Anglo-Scottish Union of 1707. I. The economic background. *Economic History Review*, 16(3):455–467.

Tena-Junguito, A., Lampe, M., and Fernandes, F. T. (2012). How much trade liberalization was there in the world before and after Cobden-Chevalier? *Journal of Economic History*, 72(3):708–740.

Uebele, M. (2011). National and international market integration in the 19th century: evidence from comovement. *Explorations in Economic History*, 48(2):226–242.

Whatley, C. A. (1989). Economic causes and consequences of the Union of 1707: a survey. *Scottish Historical Review*, 68(186):150–181.

European Historical Economics Society

EHES Working Paper Series

Recent EHES Working Papers

2022

EHES 227 Welfare Reform and Repression in an Autocracy: Bismarck and the Socialists
Felix Kersting

EHES 226 Harmonious Relations: Quality transmission among composers in the very long run
Karol Jan Borowiecki, Nicholas Ford, Maria Marchenko

EHES 225 Urban Political Structure and Inequality: Political Economy Lessons from Early Modern German Cities
Felix Schaff

EHES 224 Health, Income, and the Preston Curve: A Long View
Leandro Prados de la Escosura

EHES 223 Boomtowns: Local Shocks and Inequality in 1920s California
Sarah Quincy, Rowena Gray

EHES 222 Poverty in early modern Europe: New approaches to old problems
Guido Alfani, Francesco Ammannati, Wouter Ryckbosch

2021

EHES 221 Human Capital and Industrialization: German Settlers in Late Imperial Russia
Viktor Malein

EHES 220 Resilience, Adaptability and Transformability: Danish Butter Factories in the Face of Coal Shortages
Sofia Teives Henriques, Paul Sharp, Xanthi Tsoukli, Christian Vedel

EHES 219 Ireland in a Danish mirror: A microlevel comparison of the productivity of Danish and Irish creameries before the First World War
Eoin McLaughlin, Paul Sharp, Xanthi Tsoukli, Christian Vedel

All papers may be downloaded free of charge from: http://www.ehes.org/