

Grain quality and seasonal patterns in grain prices: Evidence from eighteenth-century Flanders and northern Italy*

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Abstract

This article explores the reasons why seasonal patterns in historical grain prices series often deviated from the expected pattern of low prices post-harvest and gradually rising prices until the next harvest. We analyse eighteenth-century Flemish and northern Italian grain prices to focus on the role of storage technologies, alternative seasonal patterns in supply and demand, and particularly quality variation. We argue that quality was not consistent throughout the harvest year because (1) grain quality improved in store and (2) grain producers selected different qualities for sale at different times of the year. Consequently, seasonal patterns in grain prices were affected by (1) the quality of stored grain gradually improving, (2) the balance of old and new grain available for sale and (3) the dumping in the market of poor-quality old grain, not ordinarily sold, when a new, successful harvest was in sight. These factors mattered, in addition to supply-and-demand effects that varied between cereals and regions, depending on storage technologies and buyers' preferences.

Grain storage occupied an important place in daily life in pre-industrial Europe, to ensure consumption until the next harvest came in and to mitigate the impact of harvest fluctuations. A better understanding of the storage behaviour of market participants is essential to figure out how societies were able to overcome the disruptions caused by harvest fluctuations. Famines gradually faded from European history not only due to improved agricultural production but also the ability to distribute surpluses in space and time, which were impossible without storage.¹ Numerous publications exist on food storage, especially grain, dealing with technologies, stocks kept by public authorities, or the rhythm of harvesting and threshing

* The authors have made available an online appendix containing information on (1) Cases, data and source; (2) Seasonal patterns; (3) Sint-Niklaas trade volumes; (4) Market volatility; (5) Interest rates; (6) Weather observations; and (7) References. The online appendix can be accessed from the *Agricultural History Review* Volume 70 Articles page on the British Agricultural History Society website, www.bahs.org.uk.

¹ G. Alfani and C. Ó Gráda (eds), *Famine in European history* (2017); D. Collet and M. Schuh (eds), *Famines during the 'Little Ice Age' (1300–1800): Socio-natural entanglements in premodern societies* (2018); J. Dijkman and B. van Leeuwen (eds), *An economic history of famine resilience* (2019); E. Vanhaute, 'From famine to food crisis: what history can teach us about local and global subsistence crises', *J. Peasant Stud.* 38 (2011).

grain.² Yet much uncertainty remains as to the extent of stocks and people's motivations to keep them, and one of these debates is focused on seasonal patterns in grain prices.

The two main explanations for seasonal patterns in historical grain prices come from Ernest Labrousse, and from Deirdre McCloskey and John Nash.³ Both expect low grain prices shortly after the harvest, and steadily rising prices until the new harvest comes in, creating a sawtooth pattern across years. McCloskey and Nash believe grain price increases reflect storage costs. Whoever stored grain must, on average, have been covered for the costs incurred. These include barn costs and the value of spoiled grain, but the main component, according to them, is the interest on the capital tied up in the grain. While grain is kept in store, the capital it embodies cannot be otherwise gainfully applied, an opportunity cost mirrored in grain price increases. Labrousse's explanation for this pattern is based on supply and demand fluctuations during the harvest year. According to him, prices were low after the harvest because many small-scale grain producers were compelled to sell, either because they needed cash or because they lacked adequate storage facilities. Prices rose later in the harvest year, especially during the *soudure* months, when stocks from the previous harvest were running out while the new harvest was still in the fields. During these months, elevated prices benefited those able to keep stocks until then, such as large grain producers, tithe collectors or speculators. From McCloskey and Nash's perspective, the higher prices paid at this time of the year reimbursed the storage costs incurred by those able to keep reserves.

A major problem with these two accounts is that prices did not always behave as predicted. In England, in medieval as well as modern times, prices matched the model very well: low when the harvest is just in, rising afterwards.⁴ Yet elsewhere, the timing of the seasonal cycle was often different. Rye prices in Nuremberg (1498–1855), wheat prices in Chartres (1748–90), and prices of both in Saxony (1763–1874) tended to be high or rising (not low or declining), around and/or shortly after harvest time, and to drop (not rise), during winter and spring. A similar pattern is implied in Karl Persson's figures for expected returns in Cologne, Siena and Pisa (1550–1700). Likewise, wheat prices declined during the harvest year in some parts of the late medieval Low Countries, including Bruges, while rising in other parts.⁵

² For a recent overview, see W. Ronsijn and N. Mignemi, 'Introduction: stocks, seasons and sales', in W. Ronsijn, N. Mignemi and L. Herment (eds), *Stocks, seasons and sales: Food supply, storage and markets in Europe and the New World, c.1600–2000* (2019).

³ *Esquisse du mouvement des prix et des revenus en France au XVIIIe siècle* (Paris, 1932), p. 160; 'Corn at interest: The extent and cost of grain storage in medieval England', *American Economic Rev.* 74 (1984). For a recent application of the latter, see W. Keller *et al.*, 'Capital markets and grain prices: assessing the storage cost approach', *Cliometrica* 14 (2020).

⁴ G. Clark, 'Markets before economic growth: the grain market of medieval England', *Cliometrica* 9 (2015), pp. 275–9; L. Brunt and E. Cannon, 'Do banks improve financial market integration?', Royal Economic Soc. Annual Conference 2002 36 (2002), p. 6.

⁵ W. Bauernfeind *et al.*, 'Rational investment behaviour and seasonality in early modern grain prices', *European Rev. Economic Hist.* 5 (2001), pp. 287–90; M. Uebele *et al.*, 'King's law and food storage in Saxony, c.1790–1830', Paper presented at the European Historical Economics Soc. Conference, London, 6–7 Sept. 2013 (2013), pp. 8–9; G. Béaur, 'La "soudure" n'est plus ce qu'elle était. Contribution à l'étude du mouvement saisonnier du marché du blé et du marché de la terre d'après le cas de la région de Chartres au XVIIIe siècle', in J.-F. Chauvard and I. Laboulais (eds), *Les fruits de la récolte* (2007), pp. 95–9; K. G. Persson, 'The Seven Lean Years, elasticity traps, and intervention in grain markets in pre-industrial Europe', *EcHR* 49 (1996), pp. 700–1; J. Dijkman, *Shaping medieval markets: the organisation of commodity markets in Holland c.1200–c.1450* (2011), p. 295.

Furthermore, if prices behaved as Labrousse, and McCloskey and Nash claim, then storing grain longer than one year was rarely rewarding. Assuming that old grain is sold at the same price as new, all storage investments are lost when prices drop back to their base level after the harvest. For that reason, the reward for carrying over grain into the next harvest year, as Persson observed, is theoretically negative, and only positive if the next harvest turned out poor.⁶ Yet grain was regularly carried over between harvest years, as has been inferred from grain prices and other data from different parts of Europe.⁷ Direct evidence of grain being carried over has been found in farmers' account books.⁸ Among these is Liam Brunt and Edmund Cannon's recent analysis of the Corn Book of a manor near Cambridge in the first half of the nineteenth century. The bulk of this farm's wheat output was not sold until the last months of the harvest year, and almost a quarter of it was carried over into the next harvest year.⁹ If prices behaved as predicted and producers wanted to maximize profits, carrying over a quarter of the harvest would be entirely irrational.

In this article we reconsider the existing explanations for seasonal patterns in grain prices using qualitative sources and recently collected data for eighteenth-century Belgium and Italy. In so doing, our goal is to widen the current understanding of historical grain price series, by integrating factors and information stemming from the agricultural, technical and trade expertise of the time. We argue that the elements affecting seasonal patterns in prices differed according to the type of cereal and the productive and commercial contexts. More specifically, we focus on quality variation, the effects of grain producers combining commercial and subsistence strategies, as well as storage technologies and demand patterns. We find that quality was not consistent because (1) grain quality improved in store and (2) grain producers selected different qualities for sale at different times of the year. Consequently, seasonal patterns in grain prices were affected by (1) the quality of stored grain gradually improving, (2) the balance of old and new grain available for sale and (3) the dumping in the market of poor-quality old grain, not ordinarily sold, when a new, successful harvest was in sight. These factors mattered, in addition to supply-and-demand effects that varied between cereals and regions, depending on storage technologies and buyers' preferences. In the next section we discuss these and other elements shaping seasonal patterns suggested in the literature on grain prices. In the third section we describe the data used in this paper. We reconstruct seasonal patterns in prices and trade volumes in the fourth section and focus on the effect of quality variation in the fifth section. In the final section we present our conclusions.

⁶ Persson, 'Seven Lean Years', pp. 701, n. 12.

⁷ R. Nielsen, 'Storage and English government intervention in early modern grain markets', *JEcH* 57 (1997), pp. 16–17; N. Poynder, 'Grain storage in theory and history', Paper presented at the Third Conference of the European Historical Economics Soc., Lisbon, Oct. 29–30 1999 (1999), pp. 18–19; Clark, 'Markets before economic growth', pp. 279–80; R. Edvinsson, 'Harvests and grain prices in Sweden, 1665–1870', *AgHR* 60 (2012), p. 10; Uebele *et al.*, 'King's law and food storage', pp. 13, 24–5.

⁸ P. van Cruyningen, *Behoudend maar buigzaam*.

Boeren in West-Zeeuws-Vlaanderen, 1650–1850 (2000), pp. 238–41; F. Scholten, 'Landlords as rational investors? Grain storage on noble manors in the Rhineland area, 1650–1850', in Ronsijn *et al.* (eds), *Stocks, seasons and sales*, pp. 24–7.

⁹ 'A case study of corn sales: Harston Manor's corn book 1823–1842', in Ronsijn *et al.* (eds), *Stocks, seasons and sales*, pp. 70–3. See also L. Brunt and E. Cannon, 'English farmers' wheat storage and sales in the late eighteenth and early nineteenth centuries', *EcHR* 75 (2022), pp. 932–59.

II

Why did grain prices at certain times and in certain areas not behave as expected? Obviously, there are other factors that may interfere with the effect of interest rates or Labrousse's supply-and-demand scheme. A first point is that grain producers conceivably did not see their grain stores exclusively as a form of investment, but also as an insurance against the possibility of future harvest failure. Several studies, starting from McCloskey and Nash's approach and finding that grain prices did not behave as they were supposed to, have concluded that actors involved in grain production also displayed risk-aversion, holding on to some supplies regardless of the cost. Martin Uebele, Tim Grünebaum and Michael Kopsidis accept that '[s]torage decisions were a mix of commercial and precautionary behaviour', just as Walter Bauernfeind, Michael Reutter and Ulrich Woitek saw a 'cautionary savings motive' in peasant behaviour.¹⁰ While storing grain came with certain risks, it could reduce other risks, and according to Nicholas Poynder this 'convenience yield' needs to be taken into account.¹¹ Persson concluded that 'inventories were held primarily as a sort of insurance against unexpected events, to cover private consumption in the current harvest year, and for short-term speculation.' In contrast, long-term storage would only have been the domain of traders operating on a larger scale, with access to more and better information, and with substantial financial reserves to cover for losses that they were bound to incur frequently.¹²

Secondly, the quality of the grain arriving in the market may not have been consistent throughout the year. This quality was consistent only if two conditions were met: first, the grain that is sold at any time is a random sample of the entire stock, and second, the grain does not undergo any changes in quality while in store. Liam Brunt and Edmund Cannon have cast doubt on both these points. Recently, they found that old grain fetched higher prices than new, suggesting that any drop in the value of grain stocks resulted from physical losses rather than quality deterioration.¹³ In another study they argue that during years of shortage, wheat offal (i.e., poor-quality grain, impure and consisting of small or broken grains) might appear in the market in the months leading up to the new harvest, exerting a downward pressure on price levels.¹⁴

These two points interact. Grain producers combined commercial with subsistence strategies, but these were linked to different kinds and qualities of grain. It has long been observed that peasants kept their inferior grains such as rye for their own consumption, while marketing their wheat or other cash crops.¹⁵ Paul Warde saw in this 'a clear preference to cover subsistence needs first'.¹⁶ The same is probably true for poorer lots of more market-oriented crops. Grain

¹⁰ Uebele *et al.*, 'King's law and food storage', p. 26; Bauernfeind *et al.*, 'Rational investment behaviour', p. 294.

¹¹ Poynder, 'Grain storage in theory and history', pp. 14–17.

¹² Persson, 'Seven Lean Years', pp. 701–2.

¹³ Brunt and Cannon, 'Case study of corn sales', pp. 67–8; Brunt and Cannon, 'English farmers' wheat storage'.

¹⁴ L. Brunt and E. Cannon, 'Variations in the price

and quality of English grain, 1750–1914: Quantitative evidence and empirical implications', *Explorations in Economic Hist.* 58 (2015), pp. 89–90.

¹⁵ F. Braudel, *Civilization and Capitalism, 15th–18th century*, I, *The structures of everyday life: The limits of the possible* (1981), p. 134.

¹⁶ P. Warde, 'Subsistence and sales: the peasant economy of württemberg in the early seventeenth century', *EcHR* 59 (2006), p. 314.

producers generally put much greater effort into cleaning and sorting grain meant for sale than they did into grain for their own or their animals' consumption.¹⁷ Yet during the time of the year when demand and prices were high, they may not have bothered as much, just like some consumers resignedly switched to cheaper, poorer-quality alternatives in times of dearth. The arrival of cheaper varieties or lots during certain parts of the year will interfere with the expected seasonal pattern in grain prices.

Thirdly, differences in grain price patterns may reflect differences in storage technologies. Grain was not usually sold before it was threshed, but it could either be threshed right after the harvest, or stored in sheaves to be threshed later, during winter and spring. The former was the rule in southern Europe, and along the Mediterranean and Atlantic coast, whereas the latter was applied in north-west Europe.¹⁸ In north-west Europe, the rhythm of threshing was closely tied in with other agricultural operations, making it difficult for producers to deviate from the usual pattern.¹⁹ Where grain was threshed early rather than late, producers had more liberty to adjust to price expectations (or interest rates) and decide when to take their crops to the market. Conversely, where grain remained in the sheaves for longer, it could be stored outdoor in stacks, so that lack of storage space rarely created a pressing need to sell.

Fourthly, the expected seasonal pattern can be disturbed by other factors with a seasonal component. One of these is interregional arbitrage. Market integration means that supply-and-demand conditions in one market lead to adjustments in other markets. However, these adjustments may to an extent be confined to those months when the condition of roads and waterways enabled transport. For example, Dijkman hypothesized that the decline in wheat prices during the harvest year in parts of the late medieval Low Counties may be due to the arrival of overseas imports, which were interrupted in winter and resumed in spring.²⁰ More generally, market prices can be affected by seasonal fluctuations in transport costs, threshing wages, or even consumer preferences.²¹ In the months before and during harvest, uncertainty and anxiety over its outcome will add noise to the usual pattern in prices.²²

There is no room in this article to explore all these factors in detail. We reconstruct and compare seasonal patterns in grain prices in Flanders and northern Italy. We interpret similarities and differences in these patterns in light of what is known about storage technologies, consumption and demand patterns, and interregional and international trade in these two regions, but we pay particular attention to the effect of intra-year quality variation. With the notable exception of the work by Brunt and Cannon, the issue of quality variation has been mostly neglected in the study of seasonal patterns in grain prices.

¹⁷ J. Meuvret, *Le problème des subsistances à l'époque Louis XIV*, 3, *Le commerce des grains et la conjoncture* (1988), pp. 19–21, 40.

¹⁸ F. Sigaut, 'A method for identifying grain storage techniques and its application for European agricultural history', *Tools and Tillage* 6 (1988), pp. 21–4.

¹⁹ L. Herment and W. Ronsijn, 'Seasonal patterns in food markets in north-west Europe in the second quarter of the nineteenth century: the evidence of periodic markets in France, England, and Belgium, 1820 to 1850', *AgHR* 63 (2015), pp. 71–8.

²⁰ Dijkman, *Shaping medieval markets*, pp. 295–6.

²¹ Scholten, 'Landlords as rational investors?', pp. 27–32; J. Komlos and R. Landes, 'Anachronistic economics: Grain storage in medieval England', *EcHR* 44 (1991), p. 41; van Cruyningen, *Behoudend maar buigzaam*, pp. 74–5; Brunt and Cannon, 'Do banks improve financial market integration', pp. 6–7.

²² R. W. Hoyle, 'Prices and seasons in late seventeenth-century England', in Ronsijn *et al.*, *Stocks, seasons and sales*, pp. 42–9.

III

The data used for this paper are eighteenth-century prices recorded at four Belgian and three Italian markets. The Belgian data are all from markets in Flanders: Sint-Niklaas (1722–1794), Eeklo (1701–1792), Aalst (1750–1802) and Nieuwpoort (1700–1792); for Italy we have data from three markets in northern Italy: Milan (1700–1786), Romano (near Bergamo) (1718–1797) and Udine (1700–1797).

Flanders and northern Italy were internally very diverse in terms of population densities and agricultural performance and production structures. On balance, Flanders was a densely populated region but still managed to export grain in the eighteenth century.²³ In contrast, the situation in northern Italy was far more varied: some areas, such as the province of Bergamo included in this paper, were net importers of grains from other parts of Italy. Other areas, such as Milan or Udine, were, roughly, self-sufficient or even exporters of grains. However, in years of scarce harvests these areas could import cereals from central and northern Europe or from the eastern Mediterranean. Therefore, while there were areas with a strong agricultural sector, such as the low Lombardy plain around Milan, there were other areas where population densities outstripped resources. Among these were the area around Romano and the Friulian mountains near Udine, who relied on grain imports.²⁴ Market volatility differed between Flanders and northern Italy. Northern Italian markets experienced quite strong price swings with remarkable regularity. Flanders also had such price fluctuations, and even stronger shocks as in 1740, but also had longer periods of relatively stable prices (see online appendix). The impact of famines during the eighteenth century was relatively mild in both regions, except when complicated by warfare.²⁵ Despite the internal diversity of Flanders and northern Italy, markets in these regions were quite well integrated.²⁶

Grain prices in both northern Italy and Flanders were free, in the sense that governments did not directly interfere with prices. The exact arrangements differed from town to town, but in both areas public authorities recorded the prices of market transactions, without imposing them. The records served as maxima for grain purchases by public bodies and validated a sort of ‘fair price’. They were also the foundation for fixing the bread’s weight. This was where public institutions really intervened in order, basically, to mediate between the food needs (and the purchasing power) of the population and the claims to a profit of the bakers. During

²³ C. Vandenbroeke, *Agriculture et alimentation dans les Pays-Bas autrichiens* (1975).

²⁴ L. Faccini, *La Lombardia fra '600 e '700: riconversione economica e mutamenti sociali* (1988); L. Mocarelli and G. Ongaro, *Work in early modern Italy, 1500–1800* (2019), p. 26; F. Costantini, *In tutto differente dalle altre città: mercato e contrabbando di grani a Bergamo in età veneta* (2016); A. Fornasin, ‘Il mercato dei grani di Udine. Indagine per una storia dei prezzi in Friuli (secoli XVI–XVIII)’ (Nota di Ricerca no. 4 del Dipartimento di Scienze Statistiche dell’Università degli Studi di Udine, 1999); A. Zannini, ‘Sempre più agricola,

sempre più regionale. L’economia della Repubblica di Venezia da Agnadello al Lombardo-Veneto (1509–1817)’, *Ateneo Veneto* 9 (2010).

²⁵ G. Alfani *et al.*, ‘Italy’, in Alfani and Ó Gráda (eds), *Famine*; Daniel R. Curtis *et al.*, ‘Low Countries’, in Alfani and Ó Gráda (eds), *Famine*.

²⁶ V. Bateman, ‘The evolution of markets in early modern Europe, 1350–1800: a study of wheat prices’, *ECHR* 64 (2011); D. Chilosi, T. E. Murphy, R. Studer, and A. C. Tunçer, ‘Europe’s many integrations: Geography and grain markets, 1620–1913’, *Explorations in Economic Hist.* 50 (2013).

famines, public intervention in the grain market could be more intrusive, through the sale at fixed prices of cereals kept by the local food institutions (the *Annone* in Italy) or charitable and religious institutions.²⁷ More common were indirect attempts to influence prices, by prohibiting exports, ordering stocks to be brought to the markets and banning the sale of grain outside the official marketplaces.

We will look at six different cereals: wheat, rye, maize, millet, barley and buckwheat. Considering a variety of cereals from different areas allows us to see the effect of differences in quality, demand and storage technology. All these cereals were typically harvested around summer, from June to August, but the timing varied by region, crop and variety. In northern Italy, wheat and rye got ripe sooner than in Flanders; the harvest of the different so-called 'minor' cereals (millet, maize, barley and buckwheat) covered a longer period; while winter varieties (of, for example, wheat or barley) could be harvested before spring-sown varieties. Moreover, local climatic peculiarities could interfere with the general harvesting pattern.

Wheat was the highest-valued and most commercial cereal in both Flanders and northern Italy. Grain producers were more inclined to sell wheat than minor grains. For example, Flemish data show that in the early nineteenth century 23 per cent of the wheat harvest and only 12 per cent of the rye harvest appeared at the public markets.²⁸ In both regions, urban consumers preferentially ate wheaten bread, while rye, buckwheat (in Flanders), millet and maize (in Italy) figured more prominently in the diet of peasants and the poorer strata of the urban populations. During the eighteenth century, consumption of maize (in Italy) and potatoes (in Flanders) grew remarkably.²⁹

Storage technologies differed between Flanders and northern Italy.³⁰ In Flanders, all cereals except buckwheat were mostly stored in the ear in sheaves until they were threshed piecemeal during winter and spring. These sheaves could be stored indoors in barns but when space was lacking also in outdoor stacks.³¹ In contrast, northern Italian cereals were threshed shortly after the harvest and stored as kernels in granaries and warehouses, exceptions notwithstanding.³² Since most threshing was carried out much earlier in Italy, and grain in the two

²⁷ L. Clerici (ed.), *Italian victualling systems in the early modern age, 16th to 18th century* (2021); K. van Honacker, *Lokaal verzet en oproer in de 17de en 18de eeuw. Collectieve acties tegen het centraal gezag in Brussel, Antwerpen en Leuven* (1994), pp. 395–438; G. van Houtte, *Leuven in 1740, een crisisjaar: economische, sociale en demografische aspecten* (1964), pp. 50–72.

²⁸ W. Ronsijn, 'Mediated and unmediated market dependence in the Flemish countryside in the nineteenth century: two paths of rural development', *Continuity and Change* 28 (2013), p. 98.

²⁹ G. Coppola, *Il mais nell'economia agricola lombarda (dal secolo XVII all'Unità)* (1979); L. Mocarelli and A. Panjek (eds), *Maize to the people! Cultivation, consumption and trade in the north-eastern Mediterranean (sixteenth–nineteenth century)* (2020); C. Vandenbroeke, 'Aardappelteelt en aardappelverbruik in de 17e

en 18e eeuw', *Tijdschrift voor Geschiedenis* 82 (1969).

³⁰ Sigaut, 'A method'.

³¹ W. Ronsijn and L. Herment, 'Les modalités du stockage des céréales en Flandre et dans la France du nord en l'an II et III', in M. Lauwers et al. (eds), *Mises en réserve: production, accumulation et redistribution des céréales dans l'Occident médiéval et moderne (Actes des 40e journées internationales d'histoire de Flaran, Abbaye d'Arthous, 12–13 octobre 2018)* (Toulouse, 2022), pp. 109–26.

³² In northern Italy granaries and warehouses were the typical storage facilities, at least for public storage. Silos were uncommon in this part of Italy. B. Marin and C. Virlouvet (eds), *Entrepôts et trafics annonnaires en Méditerranée: Antiquité-Temps modernes* (2016). Households also used wells and pits (e.g. in Milan: Historic Civic Archive of Milan [henceforth HCAM],

regions was usually threshed before sale, the new harvest was available for marketing much sooner in Italy than in Flanders. An exception in Flanders was buckwheat, which like in Italy was threshed immediately after the harvest. Unthreshed buckwheat could not be taken from the field without great losses on the way. Neither could it be left in the fields for too long since bad weather would damage it. For these reasons it was threshed in the field shortly after the harvest, and because threshed grains are more difficult to store, especially when they were new and still damp, most of the buckwheat was sold in the months following harvest.³³ Maize in Italy, stored in large granaries (where maize usually occupied a minor place), was held in kernels like all the other grains, but part of the harvest was stored by households in the ear, hanging from the ceiling either outdoors or indoors.³⁴ Rather like buckwheat in Flanders, it was mainly a short-term supply: considered highly perishable, producers were recommended to sell it within the year, and notably by winter.³⁵

There are no direct observations of storage costs in eighteenth-century Flanders and Italy that would permit a meaningful comparison. Yet we do have two other relevant indicators: interest rates and weather observations during harvest time (for details and sources see online appendix). Eighteenth-century interest rates appear to be similar across the two areas. Our data are from rates applying to two different types of credit, heritable annuities in northern Italy and mortgages in Flanders, but in both places, almost all observations range between 3.5 and 6 per cent. Harvest-time weather observations serve as a proxy for the possible difference in grain dampness at harvest time, which affects storage costs in two ways: the extent of losses due to spoilage, or the amount of labour required to shovel threshed grain in store.³⁶ Northern Italy and Flanders have similar levels of precipitation in July, but northern Italy had more rainfall in June and August. Conversely, Flanders had more days with precipitation during July and August, and higher relative humidity, while temperatures were lower than in northern Italy. Therefore, if June's rainfall made northern Italian grain damper, it was likely to dry faster. Since Italian grain was stored threshed, it required regular shovelling when damp. Then again, losses of Flemish grain stored in outdoor stacks may have been considerable, as these were built on the ground rather than on special platforms as in England.³⁷ Fixed costs

Note 32 *continued*

Grìde, C. 3, f. 43). Occasionally, unthreshed grain could enter the town walls, as local public authorities sometimes imposed grain threshing within three days from its introduction into the town (as reported for Novara: HCAM, *Grìde*, C. 3, Grìda 1648).

³³ P. Lindemans, *Geschiedenis van de landbouw in België* (1952), pp. 72, 120; L. van Acker, 'Boekweit in West-Vlaanderen, een vergeten gewas', *Biekorf*, 105 (2005), p. 120.

³⁴ G. Cantoni, *Trattato complete di agricoltura compilato dietro le più recenti cognizioni scientifiche e pratiche* (1855), pp. 712–3.

³⁵ D. Gasparini, *Polenta e formenton. Il mais nelle campagne venete tra XVI e XX secolo* (2002), p. 30.

³⁶ With regards to agricultural output, climate

historians tend to focus on weather trends at sowing or harvest time, disregarding the after-harvest grain vulnerabilities, highly relevant for the carry-over and the actual yearly grain availability. On typical climate issues dealt by historiography see T. M. L. Wigley, M. J. Ingram and G. Farmer (eds) *Climate and history: Studies in past climates and their impact on Man* (1981); W. Behringer, *Kulturgeschichte des Klimas: Von der Eiszeit zur globalen Erwärmung* (2010) and more notably see: F. C. Ljungqvist, P. Tehjil, B. Christiansen, A. Seim, C. Hartl and J. Esper, 'The significance of climate variability on early modern European grain prices', *Climetrica* 16 (2022).

³⁷ J. Sinclair, *Hints regarding the agricultural state of the Netherlands compared with that of Great Britain* (1815), p. 82.

per unit of grain were higher in Flemish barns (which the unthreshed grain shared with the straw) than in Italian granaries, but Flemish open-air stacks had much lower construction costs. In conclusion, all these peculiarities prevent us from making any general claims about the difference in storage costs between the two regions.

Wheat, rye, buckwheat, maize and millet were mainly for human consumption, though demand for them was not in all cases consistent throughout the year. Many consumers probably turned towards grain of poorer quality or cheaper varieties when wheat prices were high.³⁸ Cheaper varieties included millet and maize in northern Italy, which were mixed in common bread, typically together with rye, varying with local food habits and taste.³⁹ However, millet and maize consumption were highest during winter and spring, when they were usually eaten as porridge. This was the cheapest way to consume them, avoiding the cost of grinding and baking. Millet soup was allegedly very popular in the cold months, also among consumers who could afford more expensive grains and who, indeed, promptly shifted towards them during the summer.⁴⁰ Last but not least, millet was not solely used for human and animal consumption but also as an effective preservative for a range of more perishable food items, such as pumpkins and melons. Above all, it was used to store the more noble grains, often being mixed with wheat in order to better preserve the latter.⁴¹ In Flanders, most barley was used for malting and brewing. The malting and brewing seasons were mainly confined to the cooler months, from October to May, because malt made during warm weather was of poor quality, and brewers avoided it.⁴² For these reasons there was a pronounced seasonal pattern in the demand for maize, millet and barley.

For these cereals, we have data covering most of the eighteenth century. Exceptions are Aalst, where our data only cover the second half of the century, while millet prices in Romano are very few and confined to the second quarter of the century. All our data are monthly prices, except for Sint-Niklaas, where we have weekly prices. To reconstruct the seasonal pattern in the prices of these different cereals, we considered the difference between the log-transformed price and the 'normal' price at that time, which is the 13-month or 53-week centred moving average of the log-transformed price at that time. This difference is later referred to as the monthly deviation from the trend. More details are provided in the online appendix, where we also look at the first differences, as well as the variability in the seasonal pattern between years. The Sint-Niklaas data also include minimum and maximum prices per week, and regularly distinguish between old and new grain, offering us a glimpse at intra-year

³⁸ Labrousse, *Esquisse du mouvement des prix*, pp. 176–7, 193, 199.

³⁹ I. Orefice, 'La politica del pane a Milano fra XVI e XVII secolo', *Gli archivi per la storia dell'alimentazione. Atti del convegno (Potenza-Matera, 5–8 settembre 1988)* (1995), pp. 659–60.

⁴⁰ R. P. Corritore, *La naturale 'Abbondanza' del mantovano: Produzione, mercato e consumi granari a Mantova in età moderna* (2000), pp. 140, note 55.

⁴¹ V. Tanara, *L'economia del cittadino in villa*, L.VII (1658), pp. 469–70. Although recommended for preserving all sorts of grains, it was typically mixed with

wheat. In an older Italian-written agronomic treatise we find that 4 *some* (unit of volume) of millet were used to properly store 10 *some* of wheat. A. Gallo, *Le venti giornate dell'agricoltura et de piaceri della villa* (1593), p. 58. This usage seems typical of rural areas; allegedly, at least in large public warehouses, millet was later replaced by sand to keep wheat cool, preventing germination. Cantoni, *Trattato completo*.

⁴² 'Malt' in *The complete farmer: or, a general dictionary of husbandry* (London, 1793). See also C. Clark, *The British malting industry since 1830* (1998), p. 4.

quality variation. Furthermore, we have data on trade volumes for Romano for the middle of the eighteenth century and for Sint-Niklaas for the second quarter of the nineteenth century. For Sint-Niklaas, there are no reasons to suppose seasonal patterns in market supplies in the second quarter of the nineteenth century would differ meaningfully from those in the eighteenth (see online appendix).

We consider three characteristics of the prices of these cereals. Firstly, we will look how prices behaved and compare this with the expected pattern of low prices post-harvest and rising prices in the subsequent months. Secondly, we consider the relation between prices and patterns in supply and demand, based on the available trade volume data and what we know about seasonal differences in demand. Thirdly, we consider the possibility of intra-year quality variation, particularly using the old and new grain prices for Sint-Niklaas, as well as other, qualitative sources.

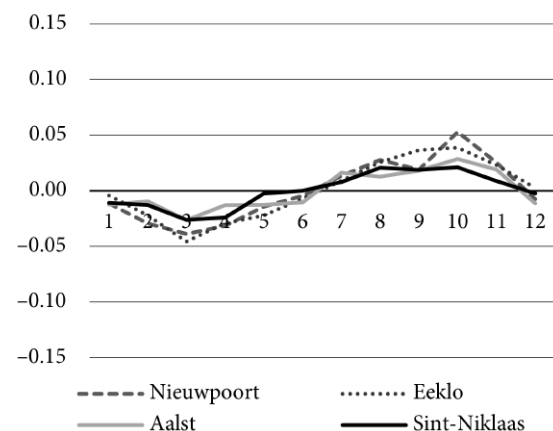
IV

Seasonal patterns in wheat, rye, maize and millet prices are shown in Figure 1; seasonal patterns in prices and trade volumes of wheat, rye, buckwheat, barley, maize and millet are shown in Figure 2. Table 1 summarizes several statistics about the seasonal price patterns. The data show that the strength, magnitude and timing of the seasonal cycle differed substantially between cereals and regions.

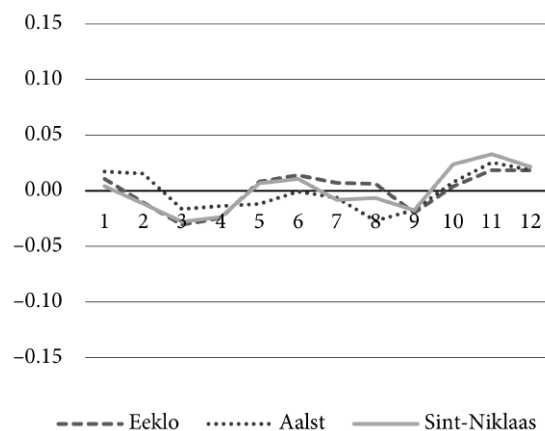
Firstly, we consider the strength of the seasonal cycle, which we define as the share of month-to-month fluctuations in the total variance in grain prices. This is what the R^2 -values of the regression show. These tended to be weak, although there were differences between markets and cereals. The seasonal pattern tended to be stronger in the Italian markets. Especially strong cycles are found for wheat and maize in Udine (resp. 35.1 and 48.5 per cent) and rye in Milan (38.6 per cent). In the Flemish markets, cycles were weaker, apart from buckwheat in Sint-Niklaas (27.8 per cent). For other cereals in Flanders, monthly differences explain less than 15 per cent of price variation. If seasonal patterns were weak, they were particularly unpredictable in the months preceding and during harvest. Both in Flanders and northern Italy, yearly fluctuations around the average seasonal cycle (shown in the online appendix) were larger from about May to September. These were the months when news regarding the state of the new harvest came out, and when markets adjusted to this news. Conversely, during the other months, from about October to April, prices stuck closer to the usual seasonal cycle.

Secondly, the magnitude of the cycle, the price difference between the cheapest and most expensive months, was often quite small as well, and strongly related to the strength of the cycle. Again, cycles tended to be larger in Italy than in Flanders. The largest cycle was again that of maize in Udine, where there was an approximately 25 per cent difference between the highest and lowest prices. In Flanders, buckwheat prices at the market of Sint-Niklaas displayed the largest cycle with about 13 per cent. In other cases, the price difference rarely exceeded 10 per cent.

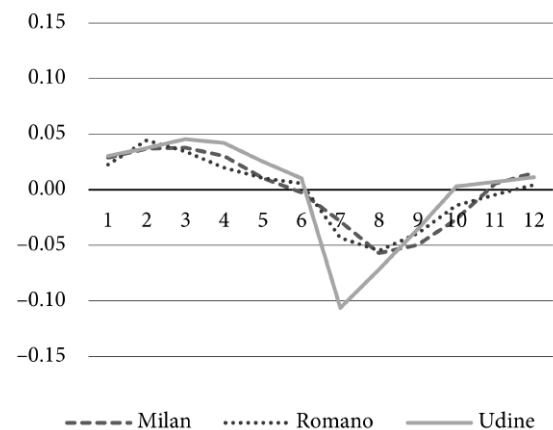
Thirdly and most interestingly, there were clear differences in the timing of the ups and downs of the seasonal cycle. The cycles looked quite similar for each cereal within either Flanders or northern Italy, showing the high degree of market integration in the two areas.



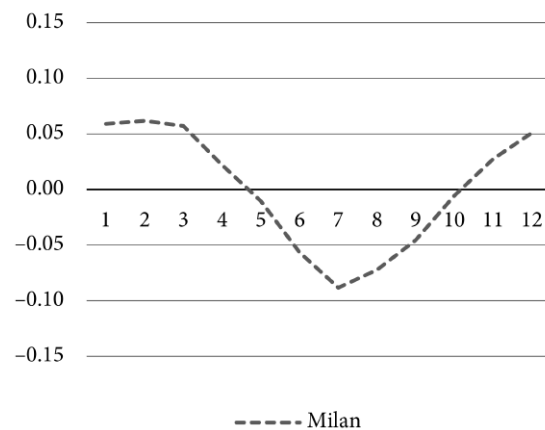
Wheat (Flanders)



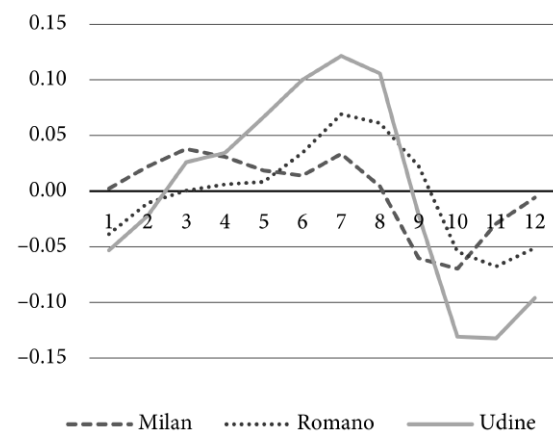
Rye (Flanders)



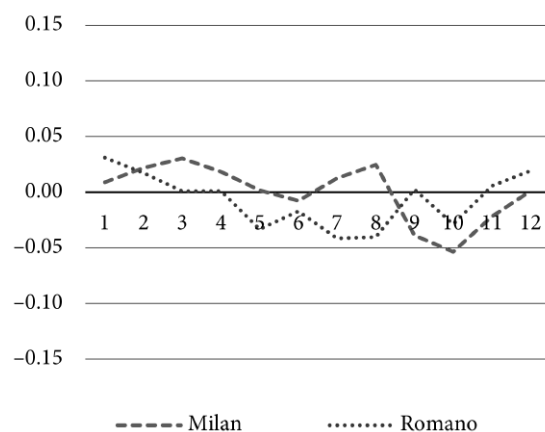
Wheat (northern Italy)



Rye (northern Italy)



Maize (northern Italy)



Millet (northern Italy)

FIGURE 1. Deviation from trend by month

Source: see online appendix.

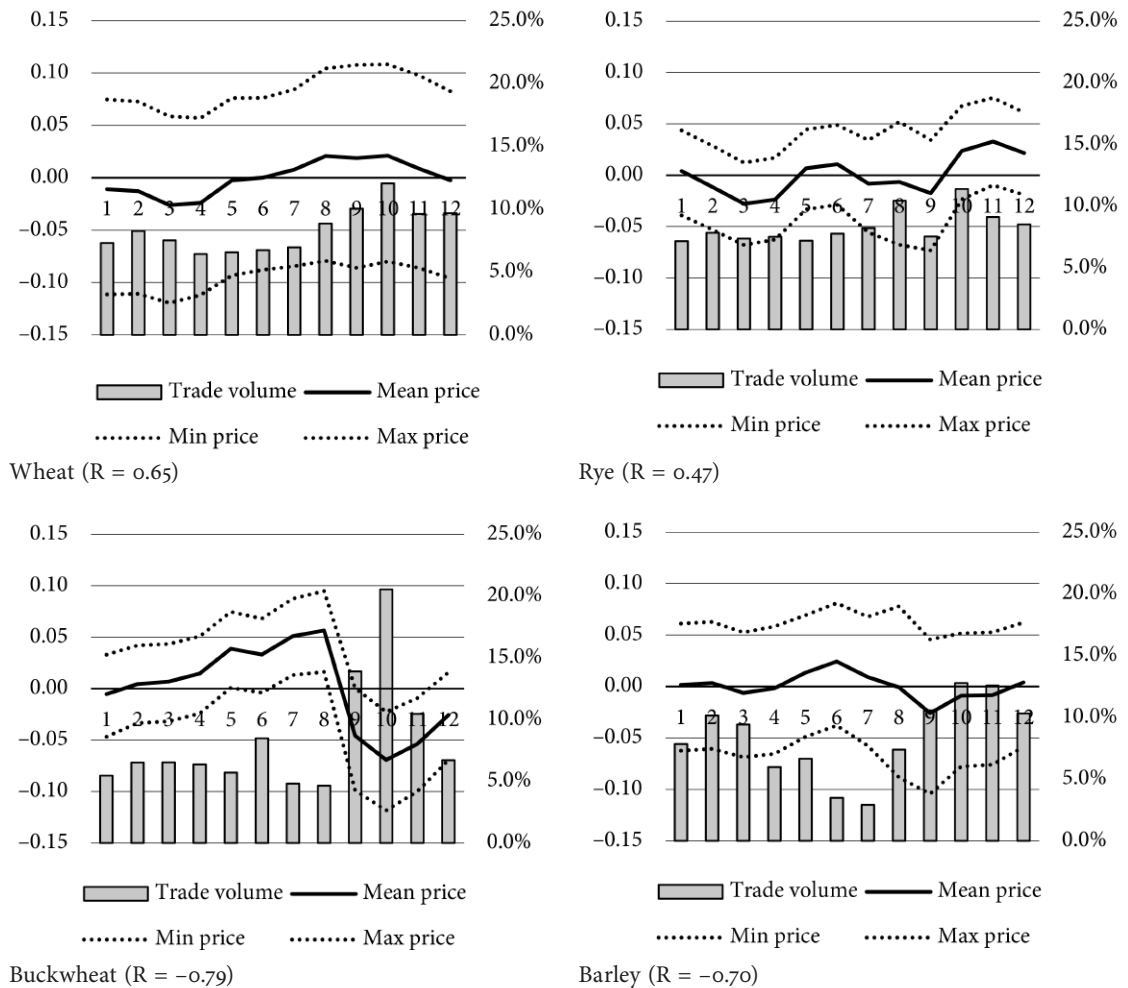
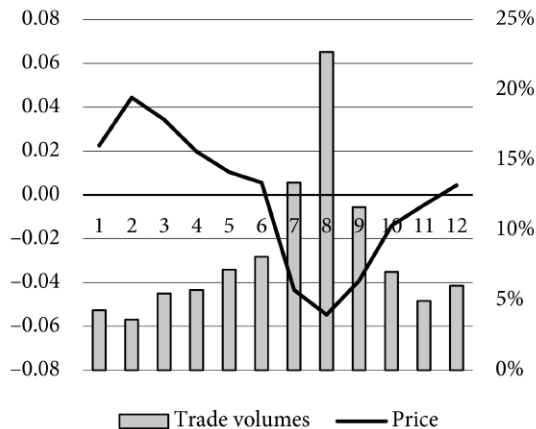


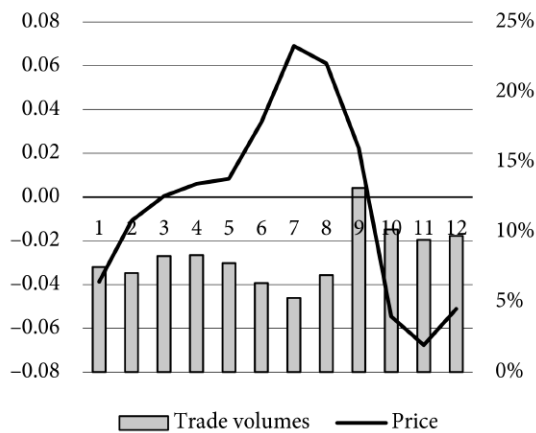
FIGURE 2a. Deviation from trend by month and trade volumes: Sint-Niklaas, Flanders

Note: Price on the left axis, trade volumes on the right axis. Correlation between trade volumes and mean price.
Source: see online appendix.

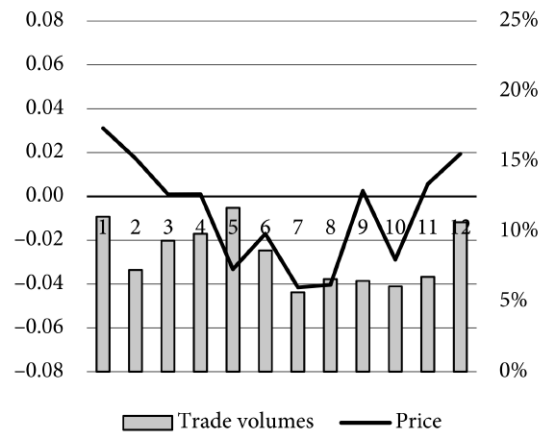
Only maize prices in Italy seemed to behave somewhat more independently, symptomatic of the trade in this crop being less intense compared to wheat. In contrast, the differences were substantial between cereals and regions. The data reveal three broad patterns. First, in several cases grain prices followed a sawtooth pattern approximating the expected pattern: wheat, rye, and maize prices in the northern Italian markets, and buckwheat and barley prices in Sint-Niklaas. In these cases, prices dropped during summer or autumn and gradually rose afterwards. However, the correspondence is imperfect: the drop in Italian wheat and rye prices predated the harvest. A second pattern can be seen in Flemish wheat prices: these likewise followed a sawtooth pattern, but with a profoundly different timing: prices were at their highest shortly after the harvest, and lowest in spring. Finally, a third pattern appears where prices display a double cycle: rye prices in Flanders and millet prices in Italy. In these



Wheat ($R = -0.85$)



Maize ($R = -0.45$)



Millet ($R = 0.40$)

FIGURE 2b. Deviation from trend by month and trade volumes: Romano, northern Italy

Note: Price on the left axis, trade volumes on the right axis. Correlation between trade volumes and mean price.

Source: see online appendix.

cases, prices have two peaks and two troughs each year. Flemish rye prices, like wheat, rose in autumn, dropped in winter, and rose in spring, but contrary to wheat they dropped again around harvest.⁴³ Italian millet prices were high in winter, average just before summer, high again during summer, and low in autumn.⁴⁴

Finding the same cycle for each cereal on all markets in the same region, but different cycles for different cereals and regions, is a clear indication that region-specific and cereal-specific factors mattered. Differences between cereals in the magnitude of seasonal cycles (minor

⁴³ The first differences (see online appendix) show that the pattern in wheat prices in Sint-Niklaas was not very dissimilar from that in rye prices, but less outspoken, and hence the overall patterns of these two cereals

in the deviation from trend diverged.

⁴⁴ There are too few observations of millet prices in Romano for the pattern to be statistically significant.

TABLE 1. Deviation from trend by month: magnitude and strength of seasonal cycle

	<i>Difference highest-lowest (magnitude)</i>	<i>R² (strength)</i>
Wheat		
Sint-Niklaas	0.047	0.068
Eeklo	0.084	0.134
Aalst	0.055	0.080
Nieuwpoort	0.092	0.140
Milan	0.095	0.263
Romano	0.099	0.191
Udine	0.152	0.351
Rye		
Sint-Niklaas	0.061	0.079
Eeklo	0.049	0.046
Aalst	0.052	0.047
Milan	0.150	0.386
Millet		
Milan	0.084	0.075
Romano	0.073	0.152
Maize		
Milan	0.108	0.114
Romano	0.137	0.138
Udine	0.254	0.485
Buckwheat		
Sint-Niklaas	0.126	0.278
Barley		
Sint-Niklaas	0.050	0.038

Source: see online appendix.

cereals often having stronger cycles) may be accounted for by substitution effects (consumers turning to cheaper alternatives when prices are high) or by fixed storage costs (rent for barn space weighing more on the price of cheaper grain) but not by interest rates. None of these factors can account for differences in the timing of seasonal cycles. To explain those, we first explore intra-year supply and demand fluctuations to account for the different cycles. Were there patterns other than the one proposed by Labrousse?

With the first type of cycle identified above, those following more or less the expected sawtooth pattern, there is a clear, inverse relation between prices and trade volumes. These were all cases where much of the harvest was threshed shortly after being gathered. In accordance

with Labrousse's model, trade volumes were largest after the harvest, and the release of these cereals appears to have pushed down prices. This is clear in the case of buckwheat and barley in Sint-Niklaas, where much of the new harvest was sold relatively soon. In the case of barley, the seasonal cycle was perhaps weaker because larger supplies after the harvest matched higher demand during the cooler months. This is also clear in the Italian maize prices. In the case of the Italian wheat prices, there is a strong boost in supplies and drop in prices around harvest time, but supplies started rising and prices dropping months before the new harvest came in.

The two other types of cycles do not display an inverse relationship with trade volumes, on the contrary. Rye prices in Sint-Niklaas and millet prices in Romano were weakly positively related to trade volumes, while the Sint-Niklaas wheat prices had a strong positive relation with trade volumes. High millet prices in winter appear to reflect the popularity of millet soups during these months, while the second peak during summer (not clear in the case of Romano because of the paucity of data) might be due to demand for millet to be used in storing the new wheat harvest.

It is striking that Flemish and northern Italian wheat prices almost mirror each other: in Flanders, wheat prices were low during winter and rising from spring to autumn; in northern Italy, the opposite happened. One hypothesis would be that the difference is due to storage technologies. Italian wheat was threshed early, explaining the post-harvest price drop. Furthermore, the release of old stocks to make room for the new harvest may have depressed prices in the months leading up to the new harvest.⁴⁵ This is the time when local big buyers, such as welfare and charity institutions, were able to take advantage of low prices to buy grain to feed people in need.⁴⁶ However, this hypothesis does not explain why in Flanders wheat prices and trade volumes were positively related. Another hypothesis would be that the difference between northern Italian and Flemish wheat prices is due to the trade balance. Supposing interregional and international trade slowed down during winter, we would expect prices to drop during that time in regions with surpluses such as Flanders and to rise in regions with a more complex situation such as Italy. From spring to autumn, when better weather would facilitate transport, prices in exporting and importing regions would converge, rising in the former and dropping in the latter. Unfortunately, we do not have the necessary data on seasonal patterns in grain transports to explore this further.

However, if the trade balance and storage technology were all that mattered, we would expect to see the same patterns in rye prices, which is not the case. Italian rye prices closely followed wheat prices, but in Flanders, while wheat prices were high after the harvest, rye prices dropped. A connection with the drop in buckwheat prices, like rye mostly consumed by the less well-off, can only partly explain the difference, as the drop in rye prices started earlier. Other factors must have mattered as well, including differences in grain quality, which we explore in the next section.

⁴⁵ June, July or August were not the sole months when grain 'dumping' could occur. It used to be recommended whenever it no longer looked like a well-preserved commodity, losing the features appreciated by merchants. Whenever grain became damp, for instance, the overall tendency was to sell it at once (*Della perfetta*

conservazione del grano. Discorso di Bartolomeo Intieri (Napoli, 1754), p. 84).

⁴⁶ Corritore, *La naturale 'Abbondanza' del mantovano: Produzione, mercato e consumi granari a Mantova in età moderna*, p. 155.

V

Another factor potentially shaping seasonal fluctuations in grain prices is quality variation. The quality of grain taken to the market can vary between seasons for two possible reasons: firstly, grain quality can change while in store, and secondly, different qualities of the same type of grain can be selected for sale at different times of the year. If this is the case, then when we are comparing grain prices at different moments during the harvest year, we are in fact comparing the prices of different commodities.

Grain storage studies often assume, implicitly or not, that grain quality during storage at best remains consistent or at worst deteriorates. While a certain portion of each harvest was undoubtedly spoilt, there are instead many contemporary accounts that grain in store changed for the better. Hence, old grain was considered better than new. The reason why is explained, among others, by Paul-Jacques Malouin, a French chemist and physician, in his 1767 *Description et details des arts du meunier, du vermicelier et du boulenger*. He argued that one should not grind grain in the year it was harvested (it is unclear whether he meant harvest year or calendar year). Grain, after the harvest, still needed time to improve, so that most (French) cereals were at their best only in their second or third year. At least, the grain needed to have passed a winter, after which it became drier, more nourishing and less fibrous. In time, the grain lost volume and weight, as it lost humidity. Yet Malouin argued that this old grain yielded more flour (at least 5 per cent), and the flour was of better quality. Bread made from new grain was perhaps tastier and better looking, yet it was believed to be less healthy and contained more fibres than bread made from old grain.⁴⁷

Other French, British and Italian sources confirm that old grain was superior and yielded more flour.⁴⁸ For example, in November 1765 the *Abbondanza* of Ferrara, the local public food institution, performed two baking tests simultaneously, to test the yield in flour and bread of old and new wheat separately.⁴⁹ The result was that one *sacco* (around 124.37 liters) of old wheat produced 91 kg of flour and around 84 kg of bread, while the same amount of new wheat produced only 88 kg of flour and around 78 kg of bread. In other words, old wheat in this case produced 4 per cent more flour and 8 per cent more bread. Other tests elsewhere, such as one in England in 1848, likewise showed old grain to yield more flour.⁵⁰ The difference in quality was the result of aging during storage that, within reasonable time limits, generally improved the yield. Contemporaries were well aware of the beneficial effects

⁴⁷ Malouin, *Description et details des arts du meunier, du vermicelier et du boulenger* (1767), pp. 17–19, 39, 258.

⁴⁸ For example: 'Corn has, by these means, been preserved in the granaries of this country for upward of thirty years, and it is observed that the longer it is kept, the more flour it yields in proportion to the corn, and the purer and whiter the bread is, there being nothing but the superfluous humidity evaporated in keeping', A. Edlin, *A treatise on the art of bread-making* (1805), p. 21; 'Granary' in *The complete farmer*; N. Chomel, *Dictionnaire économique* (1732), pp. 406–7; *The guide to trade: the miller* (1842), p. 78; Della perfetta

conservazione del grano. There was also the belief in northern Italy, which we are unable to verify, that wheat milled in August had the highest flour yield and that flour milled in this month was less perishable. Tanara, *L'economia del cittadino*, p. 26.

⁴⁹ Historical Archives of the Municipality of Ferrara (henceforth HAMF), *Finanziaria* XVIII, b. 81, f. 487.

⁵⁰ J. B. Lawes and J. H. Gilbert, 'On some points in the composition of wheat-grain, its products in the mill, and bread', *Q. J. Chemical Soc. London* 10 (1858), p. 32.

of aging, particularly during the first months after the harvest. In Ferrara, a 1796 publication on the *Abbondanza* specified that the baking tests should be made only 'when the wheat will be well-aged'.⁵¹ Likewise, in a discussion on the Assize of Bread in Sint-Niklaas in 1843, it was said that baking assays were usually not made before late October, 'when the grains have sweated'.⁵² The reason was that the weight and volume of the wheat changed while drying out, and so did its yield in flour. No matter whether grain was sold in volume or weight, new damp grain kernels were heavy and swollen due to their moisture content while old kernels were lighter and more compact. A given volume or weight of new grain therefore tended to contain more moisture and less starch than old grain. New grain was also widely considered harmful for both human and animal consumption, which is why the authorities in Naples in 1760 prohibited its introduction before the fifteenth of August (in addition to the fact that the public warehouses were still full of old grain).⁵³ Furthermore, dry, aged grain was easier to store. Old kernels, when properly dried, were ranked in the market as a premium product, not just because it yielded more flour, but first and foremost because it offered the strongest assurance against future wastage.⁵⁴ In 1722 the orders to the military warehouse keepers of the Verona province specified that they must accept only grains that were well aged.⁵⁵ In the eighteenth-century state of Milan, only well-dried grain could be traded.⁵⁶ In Bologna the local food institution paid particular attention to the period in which the wheat was purchased and moved to the public granaries (only from September onward) to avoid losses due to 'receiving it fresh from the farmyard'.⁵⁷

In the months after the harvest, old and new grain were often mixed to produce bread, because the new grain by itself was unfit for that purpose. The well-known French agronomist Antoine Augustin Parmentier wrote it was common practice in France to mix old and new grain, in order to keep the right amount of water in the mixture. Before grinding them, this sort of mixing up seems to be rather widespread and highly recommended.⁵⁸ During these first months after the harvest, grain prices from both harvests affected the market, as was observed in *Bell's Messenger*, a nineteenth-century British newspaper. In August 1825, reporting the prospect of a successful harvest, the author added the following comment on the price to be expected in the coming months:

It is known to be necessary to use a considerable portion of old wheat in working up the new corn; and hence the price of wheat is regulated, not only by the quantity of the new

⁵¹ HAME, Finanziaria XVIII, b. 100 bis, f. 84.

⁵² City archives of Sint-Niklaas, Modern, 4463, Note of 16 Oct. 1843.

⁵³ State Archives of Naples (henceforth SAN), *Regia Camera della Sommatoria*, f. 246bis: sources from the State Archives of Naples have been kindly made available by Alida Clemente.

⁵⁴ On the connection between grain quality, losses and food safety, see L. Prosperi, 'La perdita delle scorte granarie: evoluzioni di pratiche, tecniche e saperi in età moderna', in A. Clemente and S. Russo (eds), 'La polizia de' grani': *Mercati, regole e crisi di sussistenza*

nelle economie di Antico Regime (2019), pp. 91–106.

⁵⁵ State Archives of Verona, *Atti dei Rettori Veneti*, b. 801.

⁵⁶ HCAM, *Località Milanesi*, c. 75, Istruzioni a Malossari de' Grani.

⁵⁷ State Archives of Bologna, *Ambasciata Bolognese a Roma*, b. 501, folder n. 21; *Diversorum*, b. 7, f. 424; *Instrumenti*, b. 2, fos. 546–7.

⁵⁸ A. A. Parmentier, *Traité théorique et pratique sur la culture des grains suivi de l'art de faire le pain* (1802), II, pp. 503–4.

corn, but in a very considerable degree by the price and quantity of the old corn required to work with it. It is known, that this circumstance continues to affect the price of wheat for two or three months after the harvest, that is to say, until the new wheat is sufficiently hard to be ground by itself.⁵⁹

If old grain was indeed better than new, it must have left traces in the prices. Unfortunately, across Europe grain was usually sold without written references to its age. Contrary to contemporary technical handbooks, sometimes highly focused on the difference between old and new grain, administrative records only exceptionally mention grain being 'old' or 'new', in case of natural accidents due to weather or parasitosis, jeopardizing kernel integrity or preservability.⁶⁰ For that reason, the historical grain price series typically used in the literature tend to overlook the question of grain age and the importance of this point.⁶¹

The price data for Sint-Niklaas are unique in that they frequently do distinguish between old and new grain, allowing us to test whether there is a significant difference in quality between both. Most of these observations are made during or shortly after harvest time. For wheat and rye, occasionally the distinction continues to be made much later in the harvest year, but this is likely due to exceptional circumstances. In these sources, new grain obviously refers to the latest harvest; old grain can theoretically refer to any preceding harvest, but probably does not extend beyond the preceding year. Only once, in 1731, did the prices explicitly distinguish between three harvests: 1729, 1730 and 1731. Where the distinction is not made, the prices include grain from both harvests or only the latest harvest. Occasionally, seed grain is mentioned separately, during the time of sowing, but those observations are not used here. The results of a paired samples *t*-test of the difference between the average deviation from trend of weekly prices of old and new wheat, rye, buckwheat and barley are in Table 2. Averages of the deviation from trend of old and new grain prices, including the series of minimum and maximum prices, are shown in Figure 3.

The results confirm that old grain was generally sold at a higher price than new. There was an overlap, with better-quality new grain matching or exceeding the prices of poorer-quality old grain. Yet despite the large within-harvest price variance, on average old grain sold at a significantly higher price than new. There was one notable exception, namely rye sold in July. During that month, old rye was cheaper than new; in August, the difference was almost negligible; from September onwards, old rye was more expensive than new. The data provide strong evidence that the quality of the grain in the market was not consistent, but they are not conclusive about the cause of quality variation: either grain quality changed in store, or grain producers selected different qualities for sale at the beginning and end of the harvest year. The observation that the price difference for old and new rye switched in a matter of months suggests that both factors were at work.

⁵⁹ Article originally from *Bell's Messenger*, repr. in *Galignani's Messenger*, 12 Aug. 1825, p. 1, col. 2–3, p. 2, col. 1.

⁶⁰ See, among many others: *Della perfetta conservazione*. See also private and household correspondence A. Vallisneri, *Epistolario (1714–1729)* (2005): see letters

exchanged in 1720.

⁶¹ G. Ongaro and L. Prosperi, *The matter of quality in the grain market: dealing with commodities' function for a wider understanding of price dynamics. Eighteenth-century northern Italy as a case study* (forthcoming).

TABLE 2. Old and new grain in Sint-Niklaas: paired samples *t*-test of difference in mean deviation from trend

<i>Mean deviation from trend of:</i>	<i>Old</i>	<i>New</i>	<i>Difference</i>	<i>Sig.</i> <i>(2-tailed)</i>	<i>N</i>
Wheat					
July	0.159	0.002	0.157	0.008	7
August	0.033	-0.021	0.054	0.001	64
September	0.049	-0.025	0.074	0.001	48
October	0.112	-0.006	0.118	0.000	35
November	0.101	-0.056	0.157	0.000	21
December	0.126	-0.102	0.228	0.001	12
January-June	0.195	-0.099	0.294	0.000	44
Rye					
July	-0.043	0.061	-0.104	0.000	27
August	-0.016	0.005	-0.020	0.018	148
September	0.006	-0.039	0.044	0.000	68
October	0.067	0.004	0.063	0.000	30
November	0.080	-0.001	0.081	0.000	17
December	0.069	-0.049	0.119	0.000	6
January-June	0.086	-0.025	0.112	0.000	24
Buckwheat					
August	0.037	0.056	-0.019	0.631	7
September	0.079	-0.012	0.090	0.000	17
Barley					
July	0.112	-0.080	0.192	0.001	7
August	0.133	-0.076	0.209	0.000	54
September	0.090	-0.071	0.161	0.000	34

Data source: see online appendix.

For Italy, we do not have the same large number of grain price observations distinguishing between old and new.⁶² We do, however, have a handful of observations from the grain market of Legnago, one of the main grain markets of the province of Verona, on the Adige river. The local Venetian officer sent his colleague in Verona the weekly prices of the cereals (wheat, rye, millet, maize, rice) sold in Legnago, distinguishing different qualities (good, mediocre or low-quality wheat). Exceptionally, the words 'old wheat' appear in 1765, 1766 and 1781. For 1765 and 1781, we can compare these with prices of new grain, shown in Figure 4. As in Sint-Niklaas,

⁶² An explicit reference to price differences between old and new grains is reported in SAN, *Regia Camera della Sommatoria*, f. 246bis.

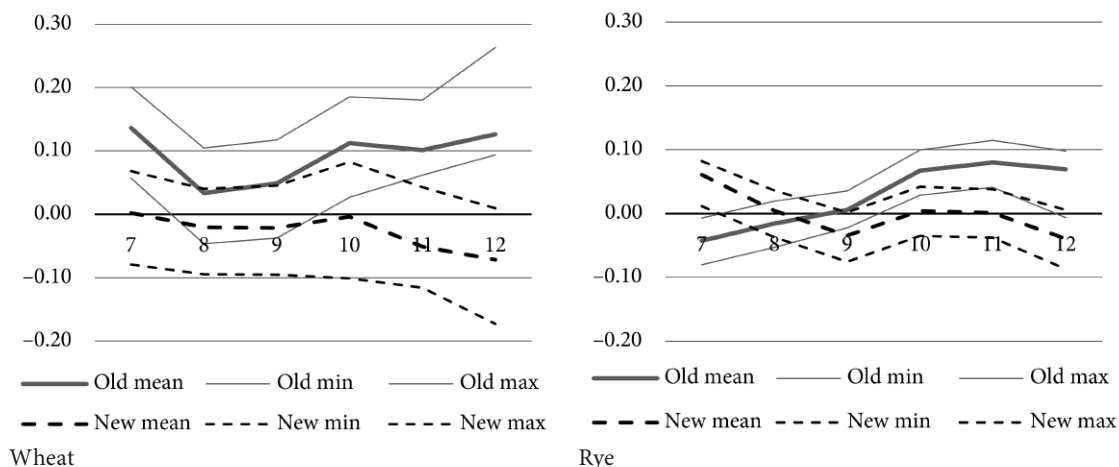


FIGURE 3. Old and new grain in Sint-Niklaas: mean deviation from trend

Note: Data for August and September are available for a larger number of years than for other months. Estimations for those other months may therefore not represent the 'normal' pattern.

Source: see online appendix.

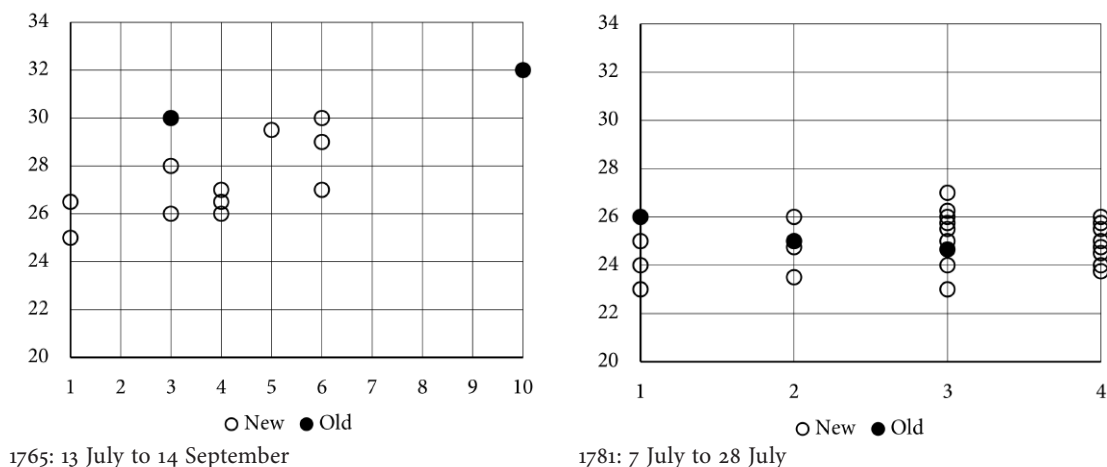


FIGURE 4. Prices of different qualities of old and new wheat in Legnago

Note: Prices in Venetian lire per 'sacco' (i.e., 114,653 litres).

Source: State Archives of Verona, Atti dei Rettori Veneti, bb. 1042, 1043, 1184.

the data show that old grain tended to be high in price, even when there was considerable within-harvest quality variation. The best new grain could get the same price or even more as old grain, as there was undoubtedly also very poor old grain.

That in Sint-Niklaas old barley and buckwheat also fetched higher prices indicates the effect of the grain becoming more compact with age. Malouin confirmed that old barley, like other cereals, produced more and better flour than new.⁶³ However, the barley sold in Sint-Niklaas

⁶³ Malouin, *Description et details*, p. 17.

was primarily meant to be malted to produce beer, and for this purpose it was essential that it germinated. Whether old barley did so as well as new is uncertain; one nineteenth-century British source called the germination of old barley 'always hazardous'.⁶⁴ It is therefore improbable that maltsters and brewers would have paid higher prices for old barley than for new, all else remaining the same. More likely is that this barley was bought as fodder. Buckwheat was strictly speaking not a cereal and was not ground for flour. The higher prices of old barley and buckwheat can reflect the sacks in which they were sold containing more kernels than sacks with new grain.

Why old rye sold in July in Sint-Niklaas did not fetch a higher price than new requires special attention. The effect of rye aging did not differ from other cereals. According to Malouin, old rye, like old wheat, was generally better than new. Furthermore, rye storage had the additional benefit that it reduced ergot in the rye.⁶⁵ More than other cereals, rye could suffer from this fungal infection that in sufficient concentrations gave those who ate contaminated rye bread a potentially lethal disease called ergotism or St Anthony's Fire.⁶⁶ It is unlikely that the superiority of old rye would appear only during its fourteenth month in storage, and hence that the switch between July and September in the old-new price difference reflects any intrinsic change in the grain in store.

A more likely explanation for the odd behaviour of rye prices is the other potential source of intra-year quality variation: producers selecting different qualities of rye for sale at different times of the year. Ordinarily, they would sell the best lots, well winnowed and cleaned, keeping poor-quality lots for their own or their animals' consumption. Towards the end of the harvest year, with a new harvest coming in, large volumes of leftover poor-quality old rye were being dumped into the market. Good-quality rye may have been hard to find around that time of the year, and exceptionally good lots of new rye fetched elevated prices. That explains the low price of old rye during summer, together with the seasonal drop in rye prices in Flanders at this time of the year. After the bulk of this poor-quality old rye was sold, the remaining better-quality old rye marketed in later months, like other cereals, fetched higher prices, whereas the new rye was sold at low prices.

The price difference between old and new grain provides us with a fresh perspective to look at seasonal cycles in grain prices. Firstly, price increases during the harvest year should at least partly reflect grain quality improving, the kernels drying out and becoming more compact. Secondly, the peaks and troughs depend not only on what happened with latest harvest, but also on how much and which qualities were being sold of the preceding harvest. Seasonal patterns in grain prices therefore cannot be understood without considering the size of the carry-over. Grain availability in early modern times should be understood on a two-year basis, grain supplies consisting of the result of the latest harvest combined with the so-called carry-over, often one-year-old grain and, more seldomly, even older grain. In Italy, the size

⁶⁴ *Farmer's Magazine* 45, Jan.–June 1874, p. 372.

⁶⁵ J. P. Frank and H. A. Bake, *Geneeskundige staats-regeling* (1789), pp. 158, 163; Malouin, *Description et details*, p. 18.

⁶⁶ T. Miedaner and H. H. Geiger, 'Biology, Genetics,

and Management of Ergot (*Claviceps* spp.) in Rye, Sorghum, and Pearl Millet', *Toxins* 7 (2015), pp. 661–2; M. Ferrières, *Histoire des peurs alimentaires* (2002), pp. 183–209.

of the wheat carry-over was likely rather small, and that of the minor grains probably even smaller. Old wheat was on occasion traded and baked: public food institutions (the *Annone*) maintained their stockpiles and supplied the bakers if needed, even in the areas where agricultural production was abundant, and also private traders in certain years put wheat in the market that was harvested one year before. For example, on several occasions (in 1715, 1736 and 1756) the *Abbondanza* of Ferrara used old wheat, or old wheat mixed with new in their baking tests.⁶⁷ Given that the wheat used for these tests was a sample of the varieties sold in the urban market and used by the bakers, in these years, exceptionally, old wheat supplied the Ferrara public and private bakeries. However, sources collected in the Republic of Venice, the State of Milan, and the Papal Legations of Bologna and Ferrara, suggest that usually in northern Italy the wheat harvest was consumed almost entirely within the same agrarian year, either in the area where it was produced, or in bordering areas with insufficient agricultural production. Therefore, in ordinary years, stocks were used up around October of the following agrarian year. The generally small amount of bread grain carried over in northern Italy is consistent with the sawtooth pattern their prices display, and could explain why seasonal cycles tended to be larger here than in Flanders. Most grain marketed after the harvest was new, and still needed some post-harvest maturation. Prices were therefore low but rose as this maturation advanced. Conversely, toward the end of the harvest year large volumes of leftover grain, sold to make storage space available for the new harvest, pushed prices down, either because the amount released for sale glutted the market, or because the remaining cereals were of poor quality, kept, like rye in Flanders, by the producers mainly for their own consumption until the next harvest would come in. For maize, where the carry-over was even smaller, price increases could be attributed not only to dropping supplies but also to the kernels drying out and becoming more compact.

Carry-overs were likely larger in Flanders. Official reports from the middle of the century mentioning the existence of considerable grain surpluses are probably exaggerated, but even Henri Delplancq, head of the Financial Council and using a more rational approach, agreed that large quantities were carried over between harvests.⁶⁸ The observation that in Sint-Niklaas in exceptional years, old wheat prices were still recorded as late as March (1756, harvest 1754) or even August (1731, harvest 1729; possibly also 1741, harvest 1739), is consistent with the existence of large stocks that could be drawn upon in time of need. These stocks had a dampening effect on the seasonal price cycle. For cereals with a larger carry-over such as wheat and rye, the existence of stores of good-quality old grain explains the counter-intuitive finding that prices here were high in autumn and declined afterwards. That old, poor-quality rye was dumped in the market at the beginning of summer interfered with this pattern and explains why the latter display a double cycle. This was less likely to happen with wheat which grain producers less often kept for their own consumption and handled with greater care. High wheat and rye prices in autumn at least partly reflect the considerable share of good-quality old grain still being sold during these months. At the same time large carry-over stores of bread grains permitted a larger part of the new harvest to age in store. The bulk of these were threshed

⁶⁷ HAMF, *Finanziaria* XVIII, b. 77, f. 266; b. 78, fos. 324–6; b. 80, f. 442.

⁶⁸ Vandenbroeke, *Agriculture et alimentation*, pp. 77–8, 84–8.

during winter and prices started dropping. Conversely, for cereals with a small carry-over such as barley and buckwheat, like maize in Italy, leftovers from the previous year had little influence. The resulting seasonal cycle fits with the expectation of low post-harvest prices, gradually increasing until the next harvest. However, our results show that this increase may not only reflect supply-and-demand conditions and storage costs, but also the grain gradually improving and becoming more compact.

VI

In this contribution, we set out to explain why seasonal patterns in grain prices in several cases deviated from Labrousse's as well as McCloskey and Nash's schemes. Our results show that there are several factors shaping the seasonal cycle, of which intra-year quality variation appears to be a major, and so far mostly neglected, aspect. Firstly, grain was not a homogeneous commodity. Grain quality differed from field to field, farmer to farmer, year to year, but also from month to month. During storage, its quality improved as it lost humidity and volume. Because of the latter, any unit of grain, whether in volume or weight, will contain more of the valued substance at the end of the harvest year than at the beginning. As the grain in store matured, its price rose. Secondly, where grain was regularly carried over into the next harvest year, the average price depended on the balance between old and new grain in the market. Carry-overs of good-quality old grain may explain the odd seasonal pattern many scholars have found, where prices are high instead of low after the harvest. These carry-over stocks permitted the new grain to mature in store, until it was better suited for bread. The need to let the new crop mature after the harvest provided an incentive to preserve the older stock for longer than one harvest year. Thirdly, grain producers pursued commercial and subsistence strategies simultaneously, and these were to a certain extent linked to different varieties and qualities of grain. They expected to make profit from certain cereals more than from others, which were grown not for the market but rather for their own and their animals' consumption. Grain producers often brought only the best part of their harvest to the market, keeping poorer lots for their own consumption. However, surpluses of these poorer lots could appear in the market towards the end of the harvest year in sufficient quantities to depress prices, interfering with the seasonal pattern. Such behaviour is consistent with grain producers combining profit-maximizing with risk-avoiding strategies. It also means that the grain being sold was not always a random sample of available stocks.

Besides quality variation, also supply and demand mattered, but there was no single pattern. What the supply-and-demand-pattern looked like, depended on the type of cereal: how it was used, how and when it was threshed and stored, and when it was consumed, imported, or exported. Some households' supplies might run out, driving up demand at the end of the harvest year. Demand for cereals used for specific purposes such as soups and porridge (maize and millet), malting (barley) or storage (millet) was highest at specific times of the year. The prospect or arrival of a new harvest and the need for space to store it could release much old grain of either good or bad quality.

Seasonal patterns depend on much more than storage costs and interest rates. We do not claim that the factors discussed in this paper entirely account for seasonal patterns instead.

What we have shown is that the factors influencing seasonal patterns were diverse and differed strongly depending on circumstances. Caution is recommended to all scholars who maintain there is a straightforward correspondence between grain prices, storage costs and interest rates, while dismissing the strong peculiarities of the preindustrial grain market.