

# The Need for Wheat

The pre-industrial Expansion of  
Vienna's Grain Supply, 1800–1840

J O N A S M . A L B R E C H T



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Abstract: Between 1815 and 1848, the population of Vienna grew from 230,000 to almost 420,000 inhabitants, making the Habsburg capital the third largest metropolis on the European continent. Occurring even before the transition from a solar-based energy system to one based on fossil fuels starting from the late 1830s, rising demand for resources exerted decisive pressure on the urban food supply system.

This paper makes two main points: first, by analysing evidence gathered from city toll registers it shows that the grain supply of the emerging metropolis was restructured decisively after c. 1830, shifting qualitatively towards wheat at the expense of rye. Second, it will be argued that this process of the wheatification of grain provisions was rendered possible by the dual expansion of the Urban Food Frontier both across the city's 'traditional' hinterland and into the Pannonian Plain. On the one hand, the local agriculture underwent a decisive shift towards the production of wheat and barley. On the other hand, as regional wheat production was insufficient to satisfy the rising urban need for wheat, Hungarian soils much further away from the place of consumption were incorporated into the city's food system. As a result, by 1840 the Austrian capital's grain supplies were largely dominated by wheat grown on the colonised steppe frontiers to the east, helping to keep food prices in the city at bay. The Urban Food Frontier expansion, locally and in the Empire's periphery, was an essential driver of intervention in both close and remote environments, ecologies, as well as societies. Further, frontier expansion itself was driven by intense official policies and commercial endeavours. This pre-industrial extension of the city's grain supply was crucial for the relations between city and hinterland. By the first half of the nineteenth century, the urban consumption of bread in Vienna was essentially bound to the fate of distant people and environments.

Keywords: Vienna, Vormärz, Pannonian Plain, urbanisation, wheatification, grain trade, urban food frontier

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### Introduction

The “urban explosion in nineteenth century Europe” (Bairoch 1988, 216) presented the continent's cities with historically unprecedented challenges to secure quantitatively and qualitatively satisfying food supplies for their quickly increasing numbers of inhabitants. Making sure enough and healthy food was available at affordable prices year-round was among the main concerns of both municipal and state administrations to prevent social unrest and upheaval, especially after 1789. The increasing amounts of food brought into the cities to sustain the urban dwellers were but the tip of the iceberg, or the result, of vast and complex underlying processes of improvements in agriculture, transportation, food processing and sanitation techniques as well as accelerating interventions in hinterland environments. However, whereas these developments regarding urban food supply have been studied and outlined extensively for both the periods before 1800 and especially after 1850, the early nineteenth century remains surprisingly absent in the international debate. This is also true for Vienna as a case study. Although the Habsburg capital was among the largest cities of the continent by mid-century, its food supply system, particularly during the Vormärz period, remains largely unexplored.

This paper aims to close that gap by investigating the effects and consequences the wave of urbanisation during the first half of the century exercised on the city's cereal supply structures just before industrialised means of transportation became available. Largely without steamships and railways, how did the exploding population change Vienna's provisioning with basic foods? Furthermore, how did the development of the centre of the Habsburg Monarchy compare to other urban experiences?

Answering these questions, the paper will proceed as follows: at the outset, a rough summary of the state of research regarding Vienna in comparison to other western urban centres is presented, followed by an overview of the demographic development of the city of Vienna before 1850. Then, the main body of the text will develop three key arguments: first, by exploring heretofore disregarded

sources and presenting a more comprehensive dataset on urban cereal provision, it will be demonstrated that Vienna experienced a notable shift in the composition of its grain supplies that can be termed as *wheatification*. Second, this shift towards wheat consumption was realised through both a substantial reorganisation and expansion of cereal production in the city's more traditional hinterland and a simultaneous expansion of the supply area into the Hungarian Pannonian Plain already before the introduction of industrial means of transportation to address the “energy and resource scarcities in the core area”. As this development “deeply influenced massive and growing human-induced environmental change,” it will be identified as the expansion of the *Urban Food Frontier* (Richards 2003, 4; Hoffmann 2001; Moore 2000). It will thus be concluded that the pre-industrial expansion of Vienna's grain supply introduced a new quality in the city's relation to its hinterland economies and ecologies. Moreover, it laid important geographic foundations for the implementation of steam-transport technologies.

### State of research

Despite the very rich literature on urban food provision, early nineteenth century, pre-industrialised grain supply has received much less attention than either the medieval or early modern periods (Charruadas 2012; Dewilde-Poukens 2011; Kaplan 1984, 1996; Keene 2012; Woolgar 2013), or the period after 1850 (Blackman 1963; Cronon 1992; Fava-Guárdia-Oyón 2016; Scholliers 1992). Studies that cover the half century between the French and March revolutions have either concentrated on other goods, especially meat (Baics 2016; Guárdia et al. 2017; Horowitz-Pilcher-Watts 2004), milk (Atkins 1977), water (Graber 2007; Tello-Ostos 2012), metals (Lestel 2012), broader approaches (Kim-Barles 2012; Scola 1992), or, increasingly, the retail sector (Alexander 1970; Alves-Morris 2017; Blonde 2009; Bohstedt 2010; Furnée 2014; Kelley 2016; Miller 2015; Mitchell 2010; Shaw-Wild 1979; Smith 2002; Stobart-van Damme 2016; Streng 2017). However, a number of valuable studies allowing for a comparative approach exist for Paris (Barles 2007; Billen et al. 2009;

Billen et al. 2012), Belgian cities (Segers 2001), Madrid (Ringrose 1983), and New York City (Swaney et al. 2012).

Regarding Paris, also experiencing a doubling of the population from 550,000 to more than one million urban dwellers, it has been shown that, although “the increase in urban pressure for food was very real during the nineteenth century,” total flour supplies doubled between the 1810s and 1850s (Barles 2007, 52). Before the introduction of railways in the 1840s, this was realised mainly through the development of water transport infrastructure, and more importantly, agricultural specialisation and intensification of grain production in the Paris basin, rather than a spatial expansion of the city’s grain hinterland (Billen-Garnier-Barles 2012). Thereby, relatively stable levels of per capita supplies were ensured throughout the period; average consumption figures rose slightly from the 1780s to the 1820s, and maintained a constant level until the 1850s (Billen et al. 2009).

A somewhat different pattern has been observed for Madrid. There, the increase of the urban population from some 160,000 to 220,000 inhabitants induced a “continued growth of the city’s grain supply area” between the end of the eighteenth and the middle of the following century (Ringrose 1983, 205). In that period, both the “fundamental reality of a politically subsidised market,” organised in a complex set of public, commercial and small-producer supply networks, and the expansion of agriculture, especially in Castilia, helped to stabilise Madrid’s bread supply, expressed in relatively stable per capita consumption estimates (Ringrose 1983, 154, 325).

Meanwhile, in New York City, growing much more spectacularly from 30,000 inhabitants in 1790 to 800,000 by 1860 (Baics 2016, 11), mechanisms of both intensification and extensive expansion of the urban supply chains appeared. The “rapid growth of agricultural production regions in upstate New York” was driven particularly by the construction of the Erie Canal, completed in 1825. Between the early 1800s and 1840, “faster and cheaper transportation [...] lowered the cost of transporting bulky crops within the NYC metropolitan area and from agricultural regions in western New York and beyond. Farmers were aided in meeting demand by technological innovations that improved crop and livestock productivity” (Swaney et al. 2012, 371). However, due to the massive population explosion, “from the 1830s through the Civil War, urban demand for [...] foodstuff in New York and elsewhere outpaced the supplies available. Even as new transportation technologies [...] linked the cities to expanding hinterlands, agricultural output failed to keep up with urbanisation [...] Judged against the favourable conditions of the Early Republican Period, antebellum New Yorkers found it more challenging to sustain their provisioning standards” (Baics 2016, 201–202).

An even more differentiated picture has been painted with regard to Belgium, where the combined population

of eight cities grew from about 270,000 inhabitants in 1800 to 460,000 by 1846 (Segers 2001, 307). Population growth and urbanisation led to “decreasing grain consumption for Ghent, Bruges, Brussels and Lier,” as well as Antwerp and Mechelen because the “Belgian agriculture, which had displayed a ‘traditional’ character up to 1850, was not in a position to satisfy the growing demand for food. The available land was limited and techniques remained more or less unchanged,” causing “a sharp increase in the retail prices of foodstuffs” and a “radical polarisation of the consumption patterns” (Segers 2001, 320–321, 326, 329). On the one hand, this was expressed in the growing consumption of potatoes by the poorer strata of the urban societies. On the other hand, there was a structural shift towards wheat consumption by those better off, realised by a notable expansion of the Belgian wheat production between 1812 and 1846 when “farmers apparently saw the way the wind was blowing and anticipated the socioeconomic shifts and the growing (urban?) demand for better-quality bread grain” (Segers 2001, 322). As a result, by mid-century, urban dwellers in Belgium consumed either more potatoes, or overwhelmingly wheat bread (Segers 2001, 322).

In comparison, Vienna’s early nineteenth century supply system has been studied only in fragments. A number of articles cover the city’s hinterland relations (Krausmann 2013), its food, feed and waste supply and disposal systems (Gierlinger 2015), or the Danube’s importance to urban resource flows from 1830 onwards (Gingrich-Haidvogl-Krausmann 2012). However, they all rather focus on the latter part of the century, and emphasise the effects of industrialisation on the urban metabolism as “the emergence of the railroad system radically changed the spatial relations between city and hinterland in the mid-19<sup>th</sup> century” (Krausmann 2013, 258). Others, focussing on Vienna’s urban administration, food policies, small-scale food retail trade, and living standards, have concluded that the early nineteenth century population growth had devastating effects. Findings on per capita consumption produced by Sandgruber suggest a degradation of average cereal supplies between the 1780s and 1830 (Sandgruber 1982a, 150). According to Oppl, “although during this period the number of inhabitants of Vienna exploded, the methods of supplying the city were not changed. Instead, they continued in the old, traditional, very inadequate patterns and had to come under decisive pressure in case of the slightest disturbances like harvest failures” (Oppl 1981, 52).

This has been considered to be due to both the failure of Vienna’s municipal and governmental administration to respond to supply challenges posed by population growth and the delayed implementation of supply improvements like railways, steamships, and steam mills. Measures to improve the urban supply system taken after

1839 were “too late to effectively prevent the supply crisis of 1845–1847/48” (Opll 1981, 53; Weigl 2014, 134).

Summarising, there are some lessons to be derived from the case studies available. First of all, Paris, Madrid, New York City and the Belgian agglomerations tightened their respective grip on hinterland resources during the pre-industrial population gains of the first decades of the nineteenth century. All of them did so either by intensifying existing patterns of resource extraction from rural areas, by expanding the space from where resources were drawn, or by combining both mechanisms—even before steam-driven transportation was implemented. Second, in all four cases, both more intensive patterns of resource allocation from hinterlands and the incorporation of new productive areas into the urban supply systems were actively driven by urban and national administrations and private interests. Municipalities, governments, investors and even farmers were involved in facilitating urban supplies through market regulations and controls, transportation improvements, and shifts in agricultural practises. In comparison, the research regarding Vienna has dismissed any of those developments for the early half of the century and has firmly argued for the failure of urban and court authorities to respond to challenges posed by population growth before 1850. In the light of the comparative literature cited, this is striking. Was Vienna’s supply system that sluggish during a time of dramatic increases in urban inhabitants? Did only steam-transport technology break the chains of pre-modern inertia and stagnation?

### Population growth

From the last third of the eighteenth century until the 1840s, when steam-powered food transport and production facilities were implemented, the city of Vienna experienced a phase of dramatic population growth. Still within the limits of a pre-industrial energy regime, the expansion during the Vormärz represents one of the most dramatic growth scenarios in the city’s history. Almost exclusively driven by immigration, the population of the urban area doubled in the decades after 1815, making Vienna one of the hotspots of European population growth (Clark 1996, 30–31). By 1815, some 230,000 people lived within the urban area, roughly as many as by the turn of the century. Then, the real boom started. During the twenty-five years after the Congress of Vienna, the annual average population increase was about three times as high as it had been in the five decades before (Weigl 2000, 50–63, 75–86). More than 170,000 people poured into the city, swelling it to just over 400,000 inhabitants by the 1840s. By mid-century, Vienna and its suburbs had surpassed a population of half a million and emerged as the third-largest urban centre of Continental Europe, excluding Russia (Lenger 2013, 53). Moreover, population growth was not confined to the

urban area. Between 1780 and 1850, the total population of the province of Lower Austria surrounding Vienna grew from 760,000 to nearly 1.1 million. Similar to urban population growth, the increase in the rural population occurred largely after the Napoleonic era (Sandgruber 1982a, 26).

### Sources

The development of Vienna’s provision with various kinds of foodstuffs, beverages, building materials, and fodder can be quantified in great detail. The information is derived from city and fiscal toll registers spanning the period from the late eighteenth to the early twentieth century.

The importation of a wide range of goods into the urban area was levied with taxes since the late seventeenth and early eighteenth centuries. From 1704, the *Linienwall*, built as a semicircular first defence line around the city, was used as customs boundary separating city and suburbs from rural surroundings. In the course of the century, the complex system of various simultaneously existing taxes supervised by different authorities was gradually simplified, until in 1811 the *Stadtmauttarif* constituted a first attempt to centralise all fees. After that date, the collection of all taxes was in the hands of the state, executed at checkpoints adjoining the city gates. In 1829, the tax system was again reorganised into the empire-wide *Allgemeine Verzehrungssteuer*, administered by the k.k. Ministry of Finance. Effective from November 1<sup>st</sup> of that year, 250 different goods were taxable upon crossing the tax limits. Important to both fiscal and municipal budgets, Vienna’s *Verzehrungssteuer* represented up to two percent of total state revenues and between seven and twenty-four percent of the city’s budget throughout the century. Consequently, only rather minor changes in tax levying and execution were made before the city toll was reformed in the wake of urban expansion in 1892 (Hauer 2014, 13–35). Both municipal and fiscal authorities created massive collections and publications of data regarding absolute import numbers, tax revenues, and, partly, exports (Hauer et al. 2012).

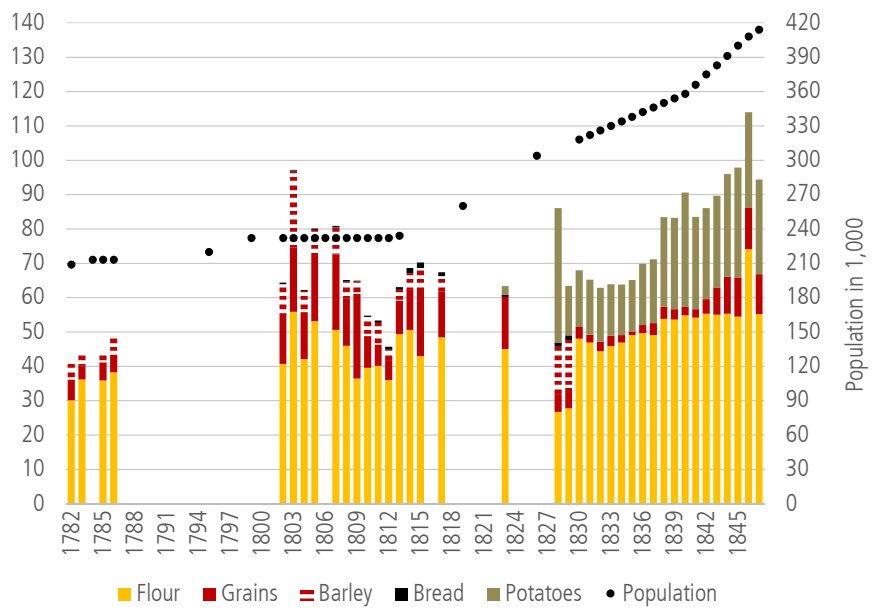
### Urban cereal provision, 1780–1847: evidence from the toll registers

Although a complete dataset is not available for the entire period, the interval information for the early and mid-1780s and the Napoleonic Era up to the Congress of Vienna combined with continuous information from 1828 onwards suffice to outline the most important trends of Vienna’s food supply up to mid-century. Yet, some hiatuses within the dataset are not avoidable. Most importantly, the supply with potatoes is continuously documented only from 1828 onwards. As potatoes did likely gain importance in the diets of urban dwellers since the late eighteenth century, this leaves a certain share

Figure 1: Annual Cereal and Potato Supply 1782–1847 in tons per annum (left), and Population (right)

Sources: Luca 1785, 274–276; Pezzl 1787, 1805, 1823; Pezzl and Tschichka 1826, 24–29; Wiener Zeitung 12 April 1806, 1586; Vaterländische Blätter für den österreichischen Kaiserstaat 17 January 1809, 20; 5 January 1810, 239; 9 January 1811, 18; 8 January 1812, 20; 13 January 1813, 24; 5 January 1814, 12; 13 January 1816, 24; Tafeln zur Statistik der Österreichischen Monarchie 1828, §95; from 1830: (Hauer et al. 2012).

Note: Grains expressed in flour weight, assuming an average milling grade of 80%. See Petersen 1995; Rahlf 1996.



of the urban food supply unaccounted for (Sandgruber 1982a, 149). Second, barley, registered as individual tax item until 1829, was subsumed into the general category of *Brotfrüchte*—cereals—thereafter. Furthermore, some individual figures, for example for 1828 and 1829, respectively, need to be interpreted very carefully.

Figure 1 shows the development of Vienna's supply with major food cereals, including potatoes, and the city's population during the last decades of the eighteenth and the first half of the nineteenth centuries. Two main patterns appear. First, regarding cereals, Vienna's provision did not keep pace with population growth after 1815. Although the city's grain supply could be drastically enhanced under the terms of the war economy, this expansion was only temporary. By the 1780s, the city was provided with a total of 40,000 to 45,000 tons of flour and grains, plus some 3,000 to 6,000 tons of barley each year. During the period of the Napoleonic Wars, significantly more food was brought into the city, and annual fluctuations were much more pronounced. While supplies with flour and grains rose to around 60,000 tons per annum in what appears as rather regular war years, barley provisions remained relatively stable. However, during the war era, both lows and peaks were drastic. In 1802–1808, year-to-year fluctuations in flour and grain imports reached nearly 20,000 tons. In the peak years of 1803, 1805, and 1807, the tax collectors recorded cereal imports nearly twice as high as during peacetime twenty years earlier. The absolute high was reached in 1803, when more than 75,000 tons of flour and grains plus a dubious amount of 22,000 tons of barley inflated the urban cereal supply to almost 100,000 tons. Downward fluctuations were equally pronounced, especially during the inflationary period. Between 1807 and 1812,

cereal provisions gradually decreased by 30,000 tons, almost halving. By the time of the Congress of Vienna in 1814 and 1815, as well as in 1817, cereal imports had recovered, again reaching levels of 60,000 tons, while barley imports remained rather average. Unfortunately, except for 1823, there is no data on urban supplies for the next decade. Comparing the single years of 1817, 1823 and 1828/1829 might suggest that at least Vienna's flour supply decreased during the economic recession of the following decade (Komlos 1983, 90–104). However, there is no sufficient data to prove that point satisfactorily. Yet, by the late 1820s, when data is available again, Vienna's flour and grain supplies had certainly withdrawn from the high war levels, although the 1828 and 1829 figures appear somewhat unreliable.

Thus, despite the large increase in the urban population, quantitatively the city's provision was hardly different from what it had been half a century ago. Around 1830, with less than 50,000 tons transported into Vienna, the city's flour and grain supply almost completely failed to respond to population growth. However, supplies started a continuous upward trend after 1832, when the pan-European cholera epidemic had hit Vienna and depressed urban food provisions to some extent. After 1833, provisions started to improve gradually, rising steadily from some 47,000 tons of flour and grain to around 65,000 tons in the mid-1840s. More precisely, the years around 1840 appear as a first caesura for the supply system. While flour supplies abruptly leaped from 1837 to 1838, when Vienna's first railway line was opened, grain imports grew even more significantly after 1842, when the city's first steam-powered flour mill started production. Nevertheless, until mid-century, the amounts of flour and grain brought into the city, then partly by industrial

Table 1: Annual Average per Capita Supply of Cereals and Potatoes, 1782–1847, in kg.

Period	5 Year Averages	
	Cereals	Potatoes
1782–1786	213	
1802–1807	333	
1808–1812	247	
1813–1817	281	
1828–1832	157	64
1833–1837	149	48
1838–1842	159	77
1843–1847	174	72

Sources: see Figure 1.

Notes: no data 1806 and 1816; 1828 and 1829 omitted due to questionable data. Compare also Sandgruber 1982a, 150

means, would not surpass the peak levels reached during the Napoleonic Wars.

Second, the stagnation in grain and flour imports was met by increasing supplies of potatoes. Although reliable information is only available from 1828/1829, according to Sandgruber it is relatively safe to assume that potatoes gained importance in the diets of both better-off and poorer strata of the Viennese society from the late eighteenth century, and especially during the Napoleonic Era (Sandgruber 1982a, 145–153). By the 1830s, they had already assumed a relatively stable and prominent position in the composition of the city’s food supply with some 15,000 tons of potatoes being imported annually before 1835. Then, provisions increased, leaping upward to around 26,000 tons in 1838 and approaching 30,000 tons per annum in the years just before the revolution.

These two patterns had far-reaching consequences for the average per capita consumption of urban dwellers. As shown in Table 1, by 1830, average per capita cereal supplies had declined radically from the levels of the 1780s. While urban residents had been supplied with more than 200 kilograms per capita per annum at the start of the period under investigation, only about 150–175 kilograms were available per capita during the Vormärz. Average consumption was lowest during the mid-1830s, when cereal availability declined to 150 kilograms, but recovered afterwards and kept rising up to the eve of revolution. Potato consumption showed a comparable trend. After having reached a low point during 1833–1837, per capita supplies were almost twice as high in the following five years, and would more or less maintain this level until 1847. In italics are shown the respective numbers for the years 1800–1817, however, these are rather unsubstantial for the analysis of average consumption due to the large

numbers of both Austrian and French troops garrisoning the city in various turns.

Thus, contrary to Paris, Vienna’s flour and grain supply did not keep pace with the city’s rapid population growth after 1815. Only after the mid-1830s did cereal supplies surpass the levels of the 1780s, though not by large before the mid-1840s. By 1845, compared with 1785, provisions had increased by about half while the population had almost doubled. Meanwhile, potatoes had gained in importance, probably since the previous century, and certainly after 1835. The result was a remarkable decline of average per capita cereal availability. Up to this point, as noted by previous research, the quantitative evidence does suggest anything but an expansion of Vienna’s grain supply before the 1840s. However, the most eminent development before mid-century was not a quantitative one—it was quality that mattered.

### The Need for Wheat

As pointed out earlier, throughout the late eighteenth and early nineteenth centuries the lion’s share of Vienna’s cereal supplies consisted of flour. Although scattered, available evidence hitherto disregarded allows analysing the composition of the city’s grain provision in more detail. This much closer look at the capital’s supplies reveals the important structural change that occurred before mid-century: the *wheatification* of grain provisions (Otter 2011, 188).

From the 1820s until mid-century, the city’s grain provision was restructured decisively, shifting qualitatively towards largely wheat-based supplies in just a few decades. Contrary to Sandgruber’s estimates, rye was almost as important as wheat before 1830 (Sandgruber 1982a, 141). Except for 1808–1812, both wheat and rye flour contributed about one third to the city’s total cereal supplies (Table 2). Although wheat imports were permanently higher than rye imports, the difference was not yet very pronounced. The same ratio probably applied to grains imported into the city untreated. In 1803, city authorities estimated grain demand at 250,000 *Metzen* of wheat and 200,000 *Metzen* of rye (Mayr 1940, 134).<sup>1</sup> After 1830 however, this ratio was unbalanced relatively quickly. Those involved in the trade already noted this development. “The bakers in Vienna,” wrote famous geographer and statistician Wenzel Blumenbach in 1835, “strongly prefer flour made of Banat wheat [...]” (Blumenbach 1835, 40). Just twenty years later, urban demand had largely shifted towards wheaten flour. According to estimates by the Lower Austrian Board of Trade, Vienna’s annual wheat consumption had risen from some 15,000–25,000 tons to more than 50,000 tons by mid-century, whereas the demand for rye had barely changed (Niederösterreichische Handels- und Gewerbekammer 1855, 18). By 1870, the President of Vienna’s Produce Exchange estimated the agglomeration’s wheat demand to be more than three

Table 2: Composition of Cereal Supplies, 1780–1855, 5 Year Averages/ Estimates

Period	Total Supply, in tons			Share of Total Supplies, in %	
	All Cereals	Wheat Flour	Rye Flour	Wheat Flour	Rye Flour
1782–1786	45,137	17,750	14,944	39	33
1802–1807	77,219	25,892	22,228	34	29
1808–1812	57,341	24,116	14,867	43	26
1813–1815/17	54,253	24,464	22,660	36	34
1828–1830/32	50,030	14,273	12,624	28	25
1850–1854	69,847	54,000	15,000	70	20
c. 1870	217,000	108,000	32,000	50	32

Sources: see Figure 1.

Notes: no data 1784, 1806, 1816. 1850–1854: Niederösterreichische Handels- und Gewerbekammer, 1855, 19; 1870: estimate for Vienna and surroundings taken from k.k. Handelsministerium, *Enquête über die Approvisionierung Wiens*, 1871, 40.

times as high as the need for rye (k.k. Handelsministerium 1871, 40). Just a few years later, Court Baker and new President of the Produce Exchange Roman Uhl in his retrospect on Vienna's flour and bread industries noted that “in the years 1820–1830, the general demand for white flour increased daily [...]” (Uhl 1873, 176).

### The Expansion of the Urban Food Frontier

The structural shift in Vienna's grain supplies towards wheat was facilitated by the notable expansion of wheat production in the urban hinterland. This expansion was an integral part of the spatial spread and intensification of land use in the province of Lower Austria during the eighteenth century, as the growing population “put intensifying demands on scarce natural resources—especially food and energy” (Richards 2003, 11). Just like “population pressures drove the expansion of arable land in Tudor and Stuart England,” when “woodlands, forests, moors, heaths, fens, and other lightly inhabited tracts were colonized, reclaimed, and settled” (Richards 2003, 123), urban and rural population growth induced the expansion of the frontier in Lower Austria after 1750. Between the 1780s and 1850s, the province's “unproductive” land was almost extinguished, declining from about one fifth of Lower Austria's total area to merely four percent (Table 3). By the middle of the nineteenth century, the area under any form of cultivation nearly equalled the province's total surface of 1.982,500 ha. Formerly non-productive soils were turned into areas devoted to either forestry, food, or fodder production.

As the frontier milled its way into the forests, it ploughed its way into the plain. Just like “war against untamed nature was being waged” in Frederician Prussia (Blackbourn 2007, 46), the Austrian state's settlement policy with regard to agricultural expansion and modernisation, market access and the removal of trade barriers assumed a leading role in frontier expansion from

above. While in Russia “the tsarist state had extended its fortified frontier lines to make new areas safe for pioneer settlement and cultivation” during the 18<sup>th</sup> century (Richards 2003, 272), Emperors Maria Theresia and Joseph II. sent out large numbers of settlers to plough the black earth of the Hungarian and the sandy soils of the Lower Austrian frontiers (Bruckmüller 2008; Feigl 1982; Gutkas 1984). With expansion came new settlements, like Theresienfeld (1763) or Oeynhausen (1773) in Lower Austria, and many other new villages in the Banat (Sugar 1990, 142–143; Fata 2014). The draining of marshlands, construction of irrigation works and other measures to expand the surface available to agriculture followed these new foundations. Like Golden Age Dutch waterworks engineers accomplished “the land reclamation that literally changed the face and shape of whole regions” (de Vries-van der Woude 1997, 27), the enlightened Austrian state administration and Austro-Hungarian landlords developed plans and made efforts to gain more control over the empire's rivers and wetlands, especially the Danube, although much less effectively (Glassl 1970; Hohen-sinner et al. 2013; Thiel 1905–1906). One of the largest attempts at land reclamation was the partial drainage of the Hanság marsh at Lake Neusiedl southeast of Vienna. Begun by Count Esterházy in the 1770s, drainage schemes were developed and partly carried out. Between 1777 and 1780, an over three kilometres long road with 20 bridges, allowing up to four wagons to drive side by side, was constructed to improve transportation through the swamp. By the 1820s, “huge amounts of hay” grown on soils claimed from the marsh could be transported via the Hegedus Canal, built 1795–1813, to Lower Austria and Vienna (Horváth 2008, 386–389; 2011, 164).

As a result, the area devoted to the production of basic food and feedstuffs in Lower Austria grew by almost a third in the course of the early nineteenth century. Compared with the late eighteenth century, when cere-



Table 3: Land Use Change in Lower Austria, 1789–1830/50, in 1000 ha

Usage	Year	Area	% of total area	Change, %
Cultivated area, total	1789	1,608	81	19
	1830/50	1,913	96	
Unproductive	1789	374	19	-81
	1830/50	70	4	
Forestry	1789	452	23	40
	1830/50	631	32	
Arable, total	1789	740	37	10
	1830/50	815	41	
of total Arable:	1789	379	19	31
Main cereals	1830/50	497	25	
Meadows and Gardens	1789	219	11	18
	1830/50	258	13	
Pasture	1789	151	8	0,2
	1830/50	152	8	

Sources: Sandgruber, 1978b: 146–153, Tables 79, 80, 81, 83, 84, 85, 93

al production had occupied around one fifth of Lower Austria's total surface, the incorporation of frontier soils lifted this share to about a quarter by the 1850s. Moreover, additional room to grow cereals was not only gained by making land arable but also by giving already cultivated plots over to grain cultivation.<sup>2</sup>

The result of frontier expansion in Lower Austria was a decisive increase in cereal output (Table 4). Compared to the province's total annual grain production of some 300,000 tons around 1790, by the early 1850s yearly harvests approached half a million tons. Although rye and oats remained more important in terms of the actual area under cultivation and total harvest output, wheat and barley became ever more significant to the regional agriculture. Like their Belgian counterparts, Lower Austrian farmers, landowners and agronomists "saw the way the wind was blowing" (Segers 2001, 322). Indeed, wheat cultivation directly replaced rye growing to some extent, just as contemporary observers would have it (Burger 1833). By the late 1780s, Lower Austria produced some 25,000 tons of wheat and some 150,000 tons of rye per annum. Sixty years later, wheat harvests had more than doubled to about 55,000 tons, while rye crops grew by about half to 225,000 tons annually.

However, between the major grains, output increases were generated quite differently. Wheat was among the main objectives of frontier expansion—and pushing out the boundaries of the wheat frontier was the single most important response to growing demand. Within the Lower Austrian agriculture, gains in wheat harvests were almost exclusively generated through the extension

Table 4: Average Cereal Harvests in Lower Austria, 1789–1851

Cereal	Year	Harvest, 1000 t	Change, %
Wheat	1789	25	123
	1851	56	
Rye	1789	149	52
	1851	226	
Barley	1789	20	113
	1851	43	
Oats	1789	97	52
	1851	148	
Total	1789	291	63
	1851	473	

Sources: Sandgruber, 1978b: 163–166, Tables 109–112.

of cultivation before the 1860s. By mid-century, the area under wheat had grown more than twofold compared with the situation around 1790, while little or no gains in area productivity were achieved on the overall provincial level (Bruckmüller 2001, 209–212; Sandgruber 1978a, 210).<sup>3</sup> While barley cultivation followed a similar pattern, the production of both oats and rye exhibited a different behaviour. In contrast to the former, to the latter types of grain the intensification of production, that is the increase in yields per hectare, was much more important. Whereas the wheat and barley frontiers widened in the course of the first half of the nineteenth century, both the rye and oat frontiers deepened.

Yet, the regional widening of the wheat frontier was not enough to satisfy the growing urban appetite. A comparison of average wheat harvests with average wheat imports into Vienna shows how large the capital's demand loomed (Table 5). The city required nearly 18,000 tons of wheat in flour each year at the eve of the French Revolution. Since wheat delivered in form of grains and supplies for the royal court are excluded in this figure, the actual demand was probably even higher, maybe over 20,000 tons. On this scale, Vienna's consumption of wheat was almost as high as the total annual wheat output of the entire province of Lower Austria. Despite the great extension of the cultivated area, there was no real change in this ratio before the middle of the following century. Hypothetically, Vienna would still devour almost all wheat grown in the province by the 1850s.

Early nineteenth century observers were quite aware of Lower Austria's chronic deficit in wheat supplies, as agronomist Johann Burger commented around 1830: "Considerable amounts of grain need to be imported from Hungary. For the year 1830, the official customs registers document 976,814 Metzen [ca. 31,000 tons] of wheat and 1.741,024 Metzen [ca. 68,000 tons] of oats, rye, maize and barley. [...] We have to be grateful that we are

Table 5: Lower Austrian Average Wheat Harvests and Vienna's Average Wheat Supplies 1789-1857, in tons.

Year	Wheat Harvest	Vienna Wheat Supply	Period
1789	25,000	17,750	1782–1786
1851	56,000	54,000	1850s

Source: See Tables 1 and 4

provided with our neighbours' abundance, who themselves would be seriously embarrassed if we were capable to satisfy Vienna's demand ourselves" (Burger 1833, 62).

Thus, the expansion of the Urban Food Frontier across Vienna's traditional hinterland was insufficient to satisfy the capital's ever-growing need for white bread—and beer. As Burger noted, the solution was to be found in the east.

Wheat from the western parts of Hungary had been important for Vienna's provision since the Middle Ages. In contemporary descriptions of the capital, "Hungary" is mentioned regularly as a source of grain supplies (Luca 1787, 105, 399; N. N. 1803, 181; Pezzl 1816, 327). According to scattered data on grain transactions on Hungarian markets in 1772/73, the largest amounts of grain changed hands on markets in the western provinces of Hungary, and especially on markets distinctly located close to Vienna. At that time Neusiedel, a small border village just 45 kilometres east of Vienna, held the largest grain market in all of Hungary with nearly 1,500 tons of cereals sold (Dányi 2007, 177–188; Grailich 1820, 118, 124). Due to the incapability of the Austrian hinterland, population growth and wartime demand during the Seven Years' War and the Napoleonic Wars had been a major incentive for Hungarian landlords to convert waste lands into arable soils, especially in the border districts of Moson and Sopron. Consequently, not only "Esterházy estates close to the Danube and the Austrian border produced grain for the Vienna market" since the eighteenth century (Gates-Coon 1994, 88, Kállay 1980), and Moson county was considered "one of the granaries of Vienna and Austria" by 1820 (Grailich 1820, 108). However, before the turn of the century "profits from [...] estates less favourably situated, further south in Vas and Somogy counties and far down the Danube, were limited by economic handicaps common to most of Hungary: difficult, costly transportation and dependence on a weak local market" (Gates-Coon 1994, 88; Blum 1948, 92–95; Orosz 1971, 6; Szántay 2014, 269–270; Vári 2008, 25). Cereal transports from central Hungary remained unprofitable, except for times of dearth like 1771/72, and these districts were much less important for the supply of the Habsburg capital by the late 1700s. With the turn

of the century, this would change. Following the rise in grain prices since the late eighteenth century, "demand for Hungarian grain—in the hereditary provinces and the army—grew steadily from the middle of the century, and especially the final twenty or thirty years. When this could no longer be satisfied by the feudal manors of the Lesser Hungarian Plain, grain started to be transported from the Great Plain" (Rácz 2013, 217).

This expansion of the frontier was greatly facilitated by the state. Settlement programs to colonise the fertile plains of the Banat and Bačka provinces and boost agricultural production had been at the heart of the imperial policies of both Maria Theresia and Joseph II. since the middle of the eighteenth century (Fata 2014). At first, mainly the areas along the Danube and Tisza rivers accessible by ship were incorporated (Pinke 2014; Vári 2008, 25). However, from the 1750s on, it became obvious that it was not enough to colonise only the land—it was also necessary to conquer the water. Simultaneous to the core's settlement endeavours, the navigability of the Danube started to receive serious attention with respect to the natural, technologic, and legal conditions of water transport. The systematic navigation and mapping of the entire river between Engelhartzell and Belgrade was begun under the auspice of a court commission in 1771, resulting in extensive plans to tackle the main obstacles of shipping, particularly ship mills, bridges, overgrown riverbanks, and floodings. For that purpose, the *Navigationsdirektion* appointed engineers for certain sections of the river who were to recruit labourers locally in order to chop down trees and other vegetation overgrowing the towpaths, remove obstacles in the current, construct bridges at confluences, built dams, drain swamps, and fill up side arms where necessary (Glass 1970). At the same time, other frontier waterways also received accelerating attention (Pinke 2014).

Secondly, the state actively facilitated technological improvements of water transportation. By offering a price of 1,000 fl. to anyone who would "navigate the Danube with the best sailing ship and reduce the present freight rates" (Glass 1970, 56), Maria Theresia sought to introduce up-to-date shipbuilding technologies to her empire. In 1775, Johannes Matthäus Heppe, shipbuilder from Mainz, was appointed the modernisation of the empire's Danube fleet. Already in 1771, he had been granted to open a shipyard in Karlovac, Croatia, where he was to establish a large-scale production site for his Dutch-inspired "Rhineland ships," followed by another shipyard in Eckhartsau, near Vienna. By the late 1770s, others had picked up the new technology, such as Count Theodor Batthyány, who established a large construction site on his Croatian estates on Kupa river and secured a royal privilege to build improved ships in 1793 (Slezak 1974, 77–78). A third public measure concerned the legal circumstances of river transportation. Beginning in

1770, the *Navigationsdirektion* was to elaborate how the complex system of navigation taxes and fees could be simplified to ease trade and transportation. In this context, the state attempted to regulate the trade by creating a shippers' organisation with professional codes and qualification guidelines, as well as wage and tariff regulations for apprentices and drivers (Glass 1970).

Besides to these direct, though in their success somewhat limited state attempts, private encounters also tried to grab a slice of the pie and invested into ventures aiming to generate profits from the increasing amounts of frontier goods that literally flowed westwards. From the 1750s through the 1840s, piecemeal regulation works were carried out in the Tisza Valley where "rises in grain prices in the late eighteenth century led landowners to convert waste lands, pastures, forests and marshes [...] into arable land" (Pinke 2014, 95). The most prominent, and probably most important of these endeavours was the construction of the *Franzenscanal* by the *k.k. priv. ung. Schiffahrts-Gesellschaft* between 1793 and 1801, which shortened the route from Timisoara to Vienna by 250 kilometres (Petrovic 1982). In its first year of operation, some 10,000 tons of grain passed through the waterway, largely shipped towards Austria. These numbers reached 40,000 to 60,000 tons at the height of the Napoleonic Wars, declined to about 30,000 tons in the years afterwards and again reached 60,000 to 70,000 tons by the 1820s and 1830s (Benda 1973, 187–198; Hesperus 59, December 1815, 470; Allgemeine Handlungs-Zeitung, 2 May 1819; Wiener Zeitung 8 June 1824, 26 March 1825, 1 September 1827, 14 December 1833).

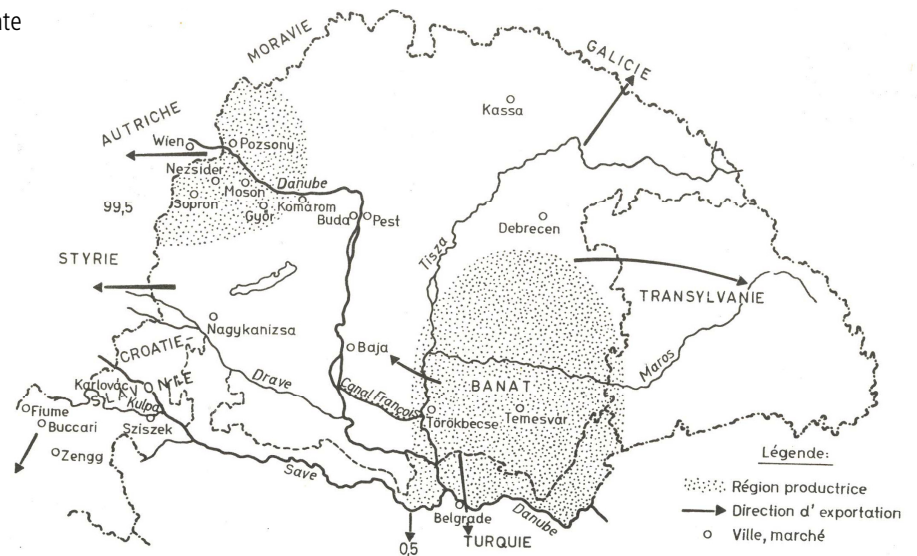
Liberalised from trade restrictions in 1817, the supply of frontier wheat as the prime cereal of choice to Vienna's flour and bread producers was ensured by vast grain trading networks unfolding eastwards, partly controlled by Jewish wholesale firms that almost all did at least "a little business in grain" (Hanak 1992, 65–68; Csendes and Oppl 2006, 79). Within these networks, merchant firms in Vienna, Bratislava or Budapest had very close business links with the grain growing regions through a number of intermediaries, such as itinerant merchants, shopkeepers or innkeepers, who were centrally involved in the local and regional grain trade. Bought by agents in the producing regions, the grain was shipped westwards via the Tisza and Danube rivers. Having passed the *Franzenscanal*, the caravans of *Kelheimer* barges mainly used in grain transportation entered the Danube near Bezdan. Up to forty meters long and seven meters wide, the ships had carrying capacities of 300 to 500 tons. Each needed up to eight boatmen, 30 drivers and 40 horses to be hauled upriver as well as pioneers, cooks and other staff to be operated. Usually, a caravan consisted of three to four barges, each with three to four additional steering boats, making these shipments the endeavour of several hundred men and horses (Blumenbach

1835, 182; Neweklowsky 1952, 181, 291–330; Promnitzer 1994, 182). After months of perilous journey and several pit stops in trade ports such as Baja, Dunaföldvár or Pest along the Danube, the caravans would reach the town of Győr situated east of Vienna on a side arm of the Danube (Figure 2). There, the large barges could go no further. Called "bad waters," in this area the main branch of the Danube was fragmented into several shoal, winding arms with unpredictable winds, currents and sandbanks that made the journey onwards dangerous and long (Hauer-Hohensinner-Spitzbart-Glasl 2016). Consequently, in Győr the cereals bound for Vienna and Lower Austria were reloaded into smaller ships and carried on the river's side arm to Moson. There, water transport finally ended. The ships were unloaded and the grain eventually driven towards Vienna, less than a two-day journey by horse cart (Horváth 2011, 182; Winkler 1872, 87–90). Given these circumstances, in the course of the early nineteenth century Moson and Győr became the epicentres bundling the growing streams of frontier wheat. Whereas around 1820 some 300 ships unloaded about 60,000 tons of grains into Moson's granaries, those figures grew to more than 220,000 tons and about 2000 ships by the early 1840s. By that time, most of the town's population were involved in the trade as agents, brokers, drivers, accountants or by simply renting out their basements as grain store facilities (Ditz 1867, 385–387; Grailich 1820, 118; N.N. 1845). Moson's position had become so important that only about one tenth of Vienna's grain supplies arrived directly in the city via the Danube waterway (Gingrich-Haidvogel-Krausmann 2012, 288). Further, the town had developed storage facilities large enough to make separate granaries in Vienna virtually unnecessary and unprofitable, a fact often bemoaned by Viennese merchants and politicians (Heller 1901, 13–17; k.k. Handelsministerium 1871, 39–48, 63–74). As traveller-geographer Johann Georg Kohl noted, Moson, "Raab [Győr] and Timisoara can be called the endpoints of a great shipping line, of which Raab lies near to an area in need (Vienna), whereas Timisoara is located in the centre of a grain-growing country" (Kohl 1842, 205–206).

From the Moson and Győr magazines, merchants and agents would bring grain samples to Vienna, where they met on Wednesdays and Saturdays with millers, brewers and other traders at the *Mehlgrube* and a small number of other distinctive taverns, the business's informal meeting points (Heller 1901, 13). After sales were agreed upon, instructions were sent back to local hauliers contracted to transport the purchases to the mills in Vienna's hinterland or, in the case of international purchases, to Nußdorf north of Vienna, where the cargo would be reloaded on ships bound northwards (N. N. 1845).

Thus triggered, Hungarian grain production grew significantly. Cereal outputs more than doubled in Moson County between 1769 and 1844, grew more than tenfold

Figure 2: Grain Exportation from Hungary, late eighteenth and early nineteenth centuries  
 Source: Benda 1973, 195



in the counties of Pest and Bács-Bodrog, and more than fivefold in Békés County (Komlos 1983, 54). Decisive tendencies towards market integration between Austria and Hungary appeared during the Vormärz. Wheat prices in Hungarian and Austrian markets converged rapidly between 1811 and 1826 and there was a significant wheat price correlation between Vienna and Hungarian as well as Banat markets already before 1847 (Cvrcek 2013, 15; Dányi 2007, 32–34). As the growth of Hungary’s agricultural sector “was contingent on exports to Vienna” (Komlos 1983, 89), steppe wheat gained importance for the capital’s supply system.

When the Vormärz era ended, the Urban Food Frontier expanded deep into the Pannonian Plain. Hungarian grain exports towards the Austrian lands had increased from around 90,000 tons by the 1780s to 130,000 tons in the early 1830s and reached more than 300,000 tons before mid-century (Hassinger 1964, 87; Komlos 1983, 60, 75–76). In Vienna, the sheer, constantly growing quantities of Pannonian frontier wheat floating down the Danube helped to ease the pressures of rising demand after the financial and supply turmoil of the first fifteen years of the century (Figure 3). Following the peak of 1816, when the eruption of Mount Tambora had caused the Year Without a Summer, wheat prices in the Austrian capital essentially declined more or less to pre-war levels and remained relatively steady throughout the 1830s and early 1840s, despite of the huge population growth.

By the 1820s, advertisements for “real, good flour made from famous Banat wheat” produced by local mills appeared in Vienna’s major newspapers (e.g. Wiener Zeitung, 18 May 1821, 992, and 11 December 1822, Allgemeines Intelligenzblatt, 1125; 30 December 1833, 726). In 1836, a trade report from Bratislava, an important intermediate market, remarked, “in the last two years local

harvests failed, but Hungary’s great granary, the Banat, helped out everywhere” (Wiener Zeitung, 3 November 1836, 1399), and by 1848, a petition of Vienna’s Bakers Guild argued: “The four markets [of Vienna, Stockerau, Enzersdorf and Fischamend] together do not supply the twelfth part of rye and wheat needed [...]. Surely, the quality of cereals sold on these markets does not suffice to produce the kind of flour that satisfies the requirements of local authorities and customers. As a matter of fact, Hungarian wheat sold in Wieselburg [Moson] or Raab [Győr], [is] largely covering Vienna’s flour demand [...].” (Darstellung der gewerblichen Zustände der Wiener Bäcker-Innung 1848, 3).

As an 1855 evaluation of the city’s supply system by the Lower Austrian Board of Trade reads, around mid-century, Vienna’s reliance on frontier food was taken for granted: “Wheat, the major article of Vienna’s demand, is mainly delivered from Banat, because, as is generally known, regarding fineness and quality Banat wheat is the most excellent in the entire Monarchy” (Niederösterreichische Handels- und Gewerbekammer 1855, 19).

Finally, in his already mentioned portrayal, Roman Uhl’s narration probably provides the best prosaic summary of Vienna’s food frontier expansion: “In the years 1814–1815, Banat wheat was ground in Lower Austrian mills for the first time. The flour samples established the superior quality and the bakers’ demand for this sort of flour became more and more urgent. [...] When the ‘30s began, [...] diligence and knowledge had made arable the Hungarian steppes and pusztas, and the rich yields of this blessed soil poured into all mills in Vienna’s vicinity. Trading firms were created in Wieselburg [Moson] in order to reload wheat delivered on large ships from the Banat. We see carters with countless wagons bringing Hungary’s harvests in mighty caravans to the Lower Au-

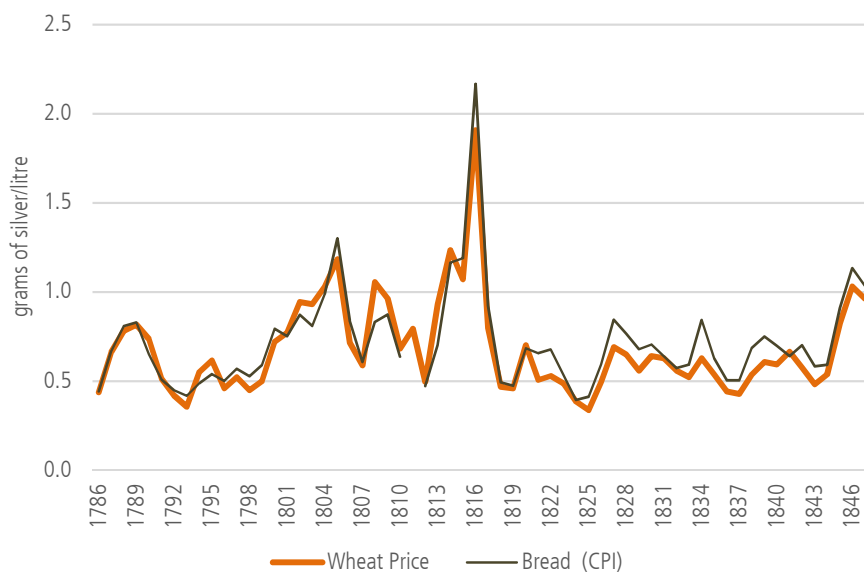


Figure 3: Annual Wheat Prices and Bread Consumer Price Index in Vienna, 1786–1847, in grams of silver per litre

Source: Robert C. Allen, *Prices and Wages in Vienna, 1439-1913*, Consumer price indices, nominal / real wages and welfare ratios of building craftsmen and labourers, 1260-1913, International Institute of Social History data files, available at <http://www.iisg.nl/hpw/data.php#austria>, accessed July 25, 2018.

striian mills, and Vienna and her vicinity are flooded with the best grains. Hungary became the granary of Vienna” (Uhl 1873, 176–177).

### Conclusion

In the course of the half-century before 1850, just before the implementation of steam-transport technologies, the city of Vienna experienced a phase of dramatic population growth, doubling in size over only three decades. Contrary to the experience of the French Capital, this pre-industrial increase of urban dwellers went hand in hand with a stagnation of the overall grain supply in quantitative terms, leading to a large decrease of average per capita consumption. However, qualitatively, supplies shifted from a balanced wheat-and-rye ratio before 1830 towards the *wheatification* of provisions until mid-century. Compared with their predecessors half a century earlier, by 1850 the diet of Vienna’s population was probably more polarised. Like in Belgium, on average, urbanites ate less bread, and more potatoes. However, bread had changed, too, as it was now wheat bread that dominated the fare. Contrary to earlier findings, this was realised through a decisive expansion of the Urban Food Frontier both across the regional agricultural system, and into the Pannonian Plain. On the one hand, the local agriculture underwent a decisive shift towards the production of wheat and barley, driven by local landowners, intellectuals, and farmers responding to demand. On the other hand, as regional wheat production was insufficient to satisfy the rising urban need for wheat, Hungarian soils much further away from the place of consumption were incorporated into the city’s food system. As a result, by 1840 the Austrian capital’s grain supplies were largely dominated by wheat grown on the colonised steppe frontiers to the east which helped

to keep food prices in the city at bay. In this sense, the case of Vienna adds important insights into the debate on feeding the city. Here, royal authorities, (local) elites and entrepreneurs seeking profits from selling agricultural products to the monarchy’s centre came together to train frontier rivers and wetlands and to cultivate frontier soils. Thus, the Urban Food Frontier expansion, locally and in the Empire’s periphery, was an essential driver of intervention in both close and remote environments, ecologies, as well as societies. Further, frontier expansion itself was driven by intense official policies and commercial endeavours. This pre-industrial extension of the city’s grain supply was crucial for the relations between city and hinterland—or core and periphery. It were the late eighteenth and early nineteenth centuries that added a new quality to urban-rural relations with regard to basic foodstuffs, even in a location not famously involved in international maritime trade like Amsterdam or London. Thus, the “emergence of the railroad system” *did not* radically “change the spatial relations between city and hinterland” (Krausmann 2013, 258) in the Austrian case. Rather, mid-century railway construction and steamship traffic only intensified commodity flows that had emerged in the course of the preceding century. Therefore, like Paris or Madrid, the city of Vienna apparently did exercise decisive, nearly empire-wide socio-economic and ecologic influences over the areas within its political control by the late eighteenth century. In contrast to Paris, however, Vienna appears to have drawn much more on the expansion of its hinterland than on the intensification of local grain production, although the Austrian capital was only half the size of the French metropolis by mid-century. In this regard, the Vienna case seems to have more in common with the experiences of Madrid and New York City, where

the recourse on external land resources apparently was the readier path to sustaining urbanisation. As a result, this paper illustrates two paths to feeding pre-industrial (western) urbanisation: intensification and expansion of resource allocation. It underlines the historical peculiarities of individual case studies, embedded in their respective social, economic, political, geographical, ecological and technical environments that need to be taken into account. In conclusion, to Vienna's population it was commonplace to regularly consume products of distant origin already well before the introduction of steam transportation, industrialisation, and globalisation. By the first half of the nineteenth century, the urban consumption of bread in Vienna was essentially bound to the fate of distant people and environments.

1. One Metzen = 61,487 litres.
2. Until mid-century, the area under the four major cereal crops, wheat, rye, barley, and oats, grew by 120,000 ha, whereas the total arable area grew only by 75,000 ha, indicating that 45,000 ha of land already used for other purposes were turned into fields.
3. To be sure, agricultural modernisation, such as summer stall feeding and increased use of manure, abolition of fallow, and implementation of leguminous crops were essential parts of the physiocratic program during the "transition from traditional to advanced organic farming". Indeed, they were highly important locally, especially on large estates. See e.g. Güldner and Krausmann (2017).

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