The Database

Three bodies of data form the foundation for this study. The registers kept by the bread price commissioners – variously called *broodzettingsregister*, *rijdingboek*, *politie*, *'t Lot van het brood*, or simply *broodboek* – supply details of the weekly prices set for the several types of bread and, often, the grain prices in the local markets or a more distant reference market. These volumes have not survived everywhere but I have reconstructed long time series for the following cities:

Holland	Other provinces
Haarlem	Groningen
Leiden	Utrecht
The Hague	Zaltbommel
Delft	Nijmegen
Dordrecht	Deventer
*Amsterdam	Zwolle
*Rotterdam	Kampen
**Alkmaar	**Leeuwarden
	**Arnhem
	**Goes

* Only fragmentary price data were found in the Amsterdam and Rotterdam archives, but the documents from other cities, especially Haarlem and Leiden, recorded bread prices for these cities, since they served as benchmarks for their own regulatory endeavors.

** These city archives provide information about regulatory policies and enforcement efforts, but no extensive price series.

Map 0.1. The Netherlands, showing cities whose grain and bread price data are incorporated in the database

The same sources, supplemented by other documents preserved in the archives of the bread price commissioners and the bakers' guilds, provide the second major body of information about the costs associated with baking that the commissioners thought necessary in the setting of official bread prices, including the fees to be paid to millers. These

documents include reports on baking trials that provide details about the milling and baking processes as well as information about the day-to-day operation of the regulatory process and its enforcement.

The third important body of evidence resides at the provincial level. All Dutch provinces levied excise taxes on the milling of grain, and the record of the tax rates and the revenues they generated provides insights not only into the course of public revenues but also into the levels and trends of bread consumption over time.

Currencies, Weights, and Measures

All of these sources, and others from neighboring countries whose experience we compare with the Dutch case, make use of currencies, weight measures and volume measures, most of which were swept aside early in the nineteenth century to make way for decimalized, national currencies and the metric system of weights and measures. Recovering the details of this old, decentralized and idiosyncratic regime is not a simple matter.

Fortunately, the Republic's monetary unit of account prevailed (nearly) everywhere and changed little in its intrinsic (silver) value. The guilder (*Carolusgulden*) divided into 20 stuivers, while the stuiver contained 16 penningen. Bread loaves of a fixed weight sold for an amount expressed in stuivers and penningen per loaf. For ease of comprehension, these prices are decimalized in the tables. Thus, a bread price of 3 stuivers 4 penningen is expressed as 3.25 stuivers.

Grain prices are expressed here in guilders and stuivers per last, or sub-units of the last. But the wholesale grain trade was one area of market life where the standard guilder system did not always prevail. Wholesale grain prices were customarily quoted in so-called gold guilders of 28 stuivers, and Zeeland wheat prices were quoted in schellingen, 6 stuivers to the schelling, even in markets in other provinces. Both can be readily converted to normal

guilders and stuivers, of course, and I have made this conversion wherever necessary. Finally, when price comparisons with foreign currencies are necessary, I convert the relevant currencies on the basis of their silver value. These values are summarized in Table 0.1 below.

Unfortunately, the relative uniformity of the Republic's money did not carry over to its system of weights and measures. The weight terminology was uniform; all Dutch towns measured in *ponden*, or pounds, divided into 32 *loden*. But the actual weight of these units varied from place to place. The Amsterdam *pond* (494 grams) was adopted in several places, and the weight standard of Cologne (the *mark* of 468 grams) appears to have influenced many other towns, but this left room for a large number of places with official weights of their own.

The volume measures used in the grain trade differed from town-to-town even more than did the weight of the pound. Fortunately, nearly all local volume measures relevant to the grain trade were sub-units of the large wholesale measure of the international grain trade, the Amsterdam last. The last measured 3003.9 liters. In Amsterdam this last divided into 36 *zakken*, or sacks. But the same last divided into 38 sacks in Haarlem and 44 sacks in Leiden – but only 29 sacks in Delft and Rotterdam. The last also divided into 27 *mudden* in Amsterdam, but 25 in Utrecht, 26 in Deventer, and 18 in Nijmegen, where it was called the *malder*. The liter volume of a *zak* or *mud* was always the appropriate fraction of the volume of the Amsterdam last. Thus the volume of the Haarlem *zak* was: 3003.9/38 = 79.05 liters. Table 0.2 below displays the pre-metric weights and measures used in this study.

The Netherlands replaced the old system of weights and measures with the metric system in 1820, although this revealed itself with some delay in the bread price records.[1] All

[1] Officially, the metric system was introduced on 1 November 1820. However, bread price records show that Zaltbommel switched to decimal measures on 1 January 1821, Kampen on 20 August 1821, Arnhem in 1823, and Leiden not until 1 January 1829.

of the local *ponden* disappeared in favor of the kilogram (known then, confusingly, as the *Nederlandsche pond*), while the volume measure became the liter together with sub-units and aggregations thereof. The largest of these aggregations remained the last, which was now set at an even 3,000 liters, which divided into 30 *mudden*, which now became a familiar name used to designate the hectoliter (100 liters).

The old currency system was decimalized in 1817.[2] The guilder remained as before, but the stuiver now became a 5 cent coin (remaining, as before, one-twentieth of a guilder), while the smallest coin, the 2 penning coin, the *duit*, was now worth just over a half-cent, which replaced it as the smallest coin. Bread prices were routinely quoted to the half-cent, eroding somewhat the promised simplicity of a decimalized currency.

In this study metric weights and measures are used as well as decimalized guilders and stuivers. Wherever possible, volume measures of grain are expressed in Amsterdam lasts.

The bread price data used in this study were recorded in their original form but have been converted to stuivers per kilogram in order to compare and aggregate observations from multiple locations. To illustrate, consider a 12-*pond* loaf of rye bread in Leiden selling at 8 stuivers 8 penningen. The monetary units were first converted to decimal form: 8.50 stuivers. Then the weight was converted to kilograms: 12 * 481 grams = 5.772 kg. This price thus becomes 8.50/5.772 = 1.473 stuivers per kg. In the case of breads sold at a fixed price and variable weight, the procedure was analogous. If a one-stuiver loaf of white bread weighed 17 *loden* in Haarlem, the weight was converted to kilograms (472 grams/32) * 17 = 250.75 grams, and the price expressed in stuivers per kg: 1/0.25075 = 3.989 stuivers per kg.

[2] Zaltbommel's price registers switched from stuivers to centen on 22 May 1817, but the conversion was not immediate everywhere. Leiden's price registers introduced the decimal currency on 5 October 1822, and Kampen switched on 12 May 1823.

Grain and Bread Price Series

This study makes use of newly constructed time series of bread and grain prices. Municipal bread price regulators recorded in their account books the bread and, often, the grain prices as they changed week-by-week. I recorded every price change and calculated monthly average prices from these notations. The monthly average is an average of the price prevailing each day of a given month, divided by the number of days in the month.[3] The monthly averages were then used to calculate annual averages.

Rye. Posthumus published a good and widely cited price series for rye. He provided monthly and annual average market prices for Prussian rye sold on the Amsterdam grain exchange (*Korenbeurs*) beginning in 1597.[4] Amsterdam was the center of Europe's international trade in grain and rye dominated this trade. As a consequence, Posthumus's rye prices series has long been treated as a fundamental point of orientation for the behavior of prices not only in the Netherlands but also elsewhere in western Europe. Published rye prices are also available for the provincial centers of Utrecht, Arnhem and Groningen, with the first of these extending back to 1393.[5]

I have been able to supplement these existing series with rye prices gathered from the bread price administrative records for Haarlem, Kampen, Zwolle, Deventer, Zaltbommel, and

[3] For example, if in August, the price of rye bread begins at 10 stuivers, is raised to 10.5 stuivers on 12 August, and rises further to 11 stuivers on the 19th, the monthly price is: (11 * 10 st) + (7 *10.5 st) + (13 * 11 st) = 326.5/31 =10.53 stuivers
In a few cases the initial notations were made in a way that made these exact calculations impossible. Then the monthly average price was a simple average of the four or five weekly price declarations. While less exact, this method has little practical effect on the monthly averages.

[4] He also published other rye price data that allow for extensions of this core series before 1597. N. W. Posthumus, *Inquiry into the History of Prices in the Netherlands/Nederlandsche prijsgeschiedenis*, 2 vols. (Leiden: E. J. Brill, 1943/1946, 1964).

[5] J.A. Sillem, "Tabellen van markt-prijzen van granen te Utrecht, 1393-1644," *Verhandelingen der Koninklijke Akademie van Wetenschappen, Afd. Letteren*, n.s, vol. 3 (Amsterdam 1901); C. A. Verrijn Stuart, "Marktprijzen van Granen te Arnhem in de jaren 1544-1901," *Bijdragen tot de Statistiek van Nederland*, n.s., 26 (1903), 19-25; W. Tijms, *Groninger graanprijzen: de prijzen van agrarische producten tussen 1546 en 1990*. *Historia Agriculturae* 31 (2000).

Utrecht.[6] These additional data make it possible to construct new, composite time series for both the Western Netherlands (based on Posthumus, with supplementary observations) and the inland provinces where local rye production presumably influenced market prices. The new, composite rye price time series will allow us to test more comprehensively than before the proposition that the Baltic imports distributed from Amsterdam and the domestic supplies traded in provincial markets formed a single, integrated market. Finally, the two new regional time series for rye are combined to form a 'national' series that can be compared to the price series developed by Arthur van Riel for the nineteenth century as part of the Project to Reconstruct Dutch National Income.[7]

Wheat. Constructing a time series of annual wheat prices is a more complicated matter. To begin with there is no existing series with continuous observations of wheat prices for periods before 1709, when Posthumus's *History of Prices* comes to our assistance with Amsterdam market data.[8] Until then, one can turn to Sillem's Utrecht time series, which ends in 1644, Priester's seventeenth-century data for the Zeeland town of Goes, and Posthumus's price

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[6] The new Utrecht series is based on observations independent from those used by Sillem. Moreover, the Sillem series ends in 1644, while my series continued to 1818.

[7] Arthur van Riel, "Prices of consumer and producer goods, 1800-1913," www/iisg.nl/hpw/data.php#netherlands.

The Van Riel wheat and rye price series are published in Michael Jansen, *De industriële ontwikkeling in Nederland, 1800-1850* (Amsterdam: NEHA, 1999), p. 345.

[8] The Posthumus time series for Amsterdam wheat prices is fragmentary before 1733, when it becomes continuous, with only occasional gaps, to 1788. Recently, Mikołaj Malinowski assembled weekly Amsterdam market prices for several grades of wheat and rye traded at the *Korenbeurs*, extending from 1709 to 1788, available at www/iisg.nl/hpw/data.php#netherlands.

It is probable that Posthumus relied on the data supplied by these weekly reports, but his study presents average monthly prices while the *Korenbeurs* reports provide weekly minimum and maximum prices rather than a single average or representative price. The price spreads were not small, averaging 24 percent for Polish wheat, and 11 percent for Konigsberg wheat. However, a simple average of the weekly minimum and maximum price tracks Posthumus's data very closely: the new estimates are, on average, 0.9 percent lower and the coefficient of variation of the annual price differences is 5 percent. Because the Malinowski data are continuous and more detailed, I have used them to calculate annual prices in preference to the original Posthumus series for the period 1709–88.

quotations from the purchase records of the Amsterdam Burgher's Orphanage (BWH), which has many gaps.

A second problem concerns the comparability of the various existing series. Wheat, unlike rye, traded at substantially different prices depending on provenance, which signaled significant quality differences to purchasers. For example, in 1738 the annual average price in Amsterdam for Frisian wheat was 134.40 guilders per last, while that for Zeeland wheat was 161.00 – a 20 percent premium. Imported wheat from Konigsberg sold for 137.20, near the Frisian price, but Polish wheat shipped from Danzig sold for 158.44, near the Zeeland price.[9] While it would be desirable to have complete time series for the several grades of wheat sold in Dutch markets, this appears at present to be beyond our reach. The prices noted by bread price commissioners were sometimes for a particular grade of wheat and sometimes represented an average of the prices of several grades, weighted according to their assessment of the appropriate quality/price trade-off. The commissioners occasionally discussed these matters (more about this in Chapter 6), but not with enough consistency to allow us always to know which of the several wheat prices they were quoting. The best we can do at present is to construct time series that reflect the actual choices made by bread price commissioners as they selected the market prices they deemed relevant to the costs faced by the bakers. To this end, I have constructed time series for wheat from the bread price administrative records of Haarlem (which follows the nearby Amsterdam market), Utrecht, Kampen, and Zaltbommel. In addition, I have assembled a series of Amsterdam prices drawn from the records of two Amsterdam orphanages: the Burghers' Orphanage (BWH) and the Almoners' Orphanage (AWH). These prices are not market observations but are the average prices paid by the orphanages to supply their needs each year. While Posthumus published

[9] See Table 6.6 in the book for more details on wheat price differentials.

some BWH prices, he left many gaps that were filled by the research of Anne McCants.[10] I have used this material plus my own reconstruction of AWH records to produce an "orphanage series."

From these raw materials, I have constructed two continuous price series, one reflecting the Amsterdam wheat market and valid for the western Netherlands (where most wheat was consumed) and a new series for the eastern provinces. The first is based on Posthumus's eighteenth-century data, the seventeenth-century Haarlem and Goes price observations, and the orphanage data; the second is an unweighted average of observations for Utrecht, Kampen, and Zaltbommel. In addition, the two new series are combined to create a single national time series for the Netherlands as a whole.

Many of these new price series extend into the nineteenth century, although most of the data sources dry up well before the end of the era of bread price regulation in 1855. I have continued my series into the nineteenth century in part to compare them with that of the National Project to Reconstruct Dutch National Income, mentioned above, and test them for consistency.

Table 0.3a (see separate Excel file) displays the annual average rye and wheat prices for the western Netherlands, the eastern regions of the Netherlands, and a composite national price series. Table 0.3b (see separate Excel file) presents my calculation of western, eastern, and national prices for the period 1800-1913, drawn from the provincial data drawn together by Van Riel. The series for individual locations that stand behind these averages, and the monthly data from which the annual averages are calculated, are available in Jan de Vries, "Dutch bread and grain prices, 1594-1855," www/iisg.nl/hpw/data.php#netherlands.

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[10]Anne McCants, *Civic Charity in a Golden Age: Orphan Care in Early Modern Amsterdam* (Urbana and Chicago: University of Illinois Press, 1997), appendix C. Raw data kindly made available to the author.

Rye bread. I have assembled monthly and annual time series for rye bread for seven cities in Holland and an additional seven cities in inland provinces. After converting each to standard metric measurements, I combined the time series for Holland towns to form a composite, unweighted index of rye bread prices for the western Netherlands and did the same with the time series for the inland towns to produce a comparable composite series for the east.

Rye bread prices differed from place to place only slightly in absolute level, and their year-to-year fluctuations were highly correlated, as one would expect given the similarity of the methods in setting these prices and the high degree of integration in the underlying grain markets. See Tables 6.5 to 6.7 in the book for correlation coefficients, demonstrating the truth of this claim. Consequently, the composite regional and national series can be regarded as highly reliable.

Rye bread time series used to calculate the western and eastern averages:

West

Amsterdam,	1596-1661, 1698-1821
Haarlem,	1611-1801
Leiden,	1596-1854
The Hague	1650-1811
Delft	1640-1825
Dordrecht	1709-1816
Utrecht	1599-1841

East

Zaltbommel	1629-1849
Deventer	1594-1661, 1683-1725, 1740-1817
Zwolle	1651-67, 1694-97, 1725-1822
Kampen	1662-1843
Nijmegen	1594-1604, 1685-99, 1825-30
Groningen	1641-1853
Den Bosch	1817-49

Wheat bread. The compilation of consistent wheat bread price series faces a number of challenges. To begin with, every city recognized several types of wheat bread and their names and qualities varied from place to place. Moreover, within a given city the names and qualities of the bread types could change over time. Wherever possible, monthly and annual price averages were calculated for every type of wheat bread, city by city. But, to minimize erroneous comparisons of unlike bread types, I have constructed aggregated time series only for the cheapest wheat bread (unbolted wheat bread) and the costliest (fine white bread). Nearly all town bread price records identify these two extremes clearly, while the correct comparators for intermediate bread qualities are less certain.

The aggregated western and eastern time series are composed of observations from seven and six cities, respectively. These regional average prices are then combined in a weighted national average price for comparison with the Van Riel national time series for the nineteenth century.

Wheat bread time series used to calculate the western and eastern averages:

West

Leiden	1649-1860
Rotterdam	1610-11, 1660-1801
Haarlem	1613-1800
Delft	1640-1800
The Hague	1650-1811
Dordrecht	1709-1816
Utrecht	1599-1818

East

Zaltbommel	1629-1849
Nijmegen	1637-47, 1663-1700
Zwolle	1652-67, 1693-1821
Kampen	1662-1820
Deventer	1683-1800

Table 0.3a displays the annual average bread prices – for rye bread, coarse wheat bread, and fine white bread – for the western Netherlands (primarily Holland), the eastern Netherlands, and for the Netherlands as a whole. The individual city time series that these composite series summarize and the monthly data from which the annual series are calculated are available in Jan de Vries, "Dutch bread and grain prices, 1594-1855," www/iisg.nl/hpw/data.php#netherlands.

Finally, Table 0.3b also contains consumer price indexes (CPI) developed by Jan Luiten van Zanden (to 1800), and Arthur van Riel (1800-1913). The construction of these CPIs is detailed in Van Zanden's "Prices and wages and the cost of living in the western part of the Netherlands, 1450-1800," www.iisg.nl/hpw/brenv.php and Van Riel's "Prices of consumer and producer goods, 1800-1913," www.iisg.nl/hpw/data.php#netherlands.

Table 0.1.
Silver content of European currencies, 1550-1850 (in grams of silver per unit)

	Netherlands		England	France	Cologne	Denmark current sys.
	North	South				
	Guilder	guilder	pound sterling	livre tourn.	albus	rigsdaler
1550	19.153	19.153	114.12	15.622		
1560	18.253	18.253	115.08	15.106		
1570	17.412	17.412	115.08	14.267		
1580	13.68	13.68	115.08	11.807		
1590	11.55	11.608	115.08	11.807		
1600	11.17	11.484	115.08	11.807	0.351	
1610	10.89	10.332	111.36	10.992	0.349	
1620	10.28		111.36	10.992	0.333	
1630	10.28		111.36	10.992	0.333	
1640	10.28		111.36	8.685	0.333	
1650	10.28		111.36	8.324	0.333	
1660	9.74		111.36	7.605	0.333	
1670	9.74		111.36	8.324	0.325	21.22
1680	9.74		111.36	8.324	0.309	
1690	9.613	9.536	111.36	7.567	0.271	20.64
1700	9.613	8.856	111.36	7.276	0.245	21.5
1710	9.613	8.856	111.36	6.936	0.245	20.9
1720	9.613	8.856	111.36	3.872	0.241	18.3
1730	9.613	8.856	111.36	4.454	0.241	20.4
1740	9.613	8.856	111.36	4.454	0.241	20.3
1750	9.613	8.353	111.36	4.454	0.218	20.9
1760	9.613	8.22	111.36	4.454	0.19	20.3
1770	9.613	8.22	111.36	4.454	0.19	19.2
1780	9.613	8.22	111.36	4.454	0.19	19.5
1790	9.613	8.22	111.36	4.454	0.176	
1800	9.613		111.36			
1810	9.613	4.5	111.36	4.5		
1820	9.613	9.61	111.36	4.5		
1830	9.613	4.5	115.7	4.5		
1840	9.613	4.5	115.7	4.5		
1850	9.45	4.5	115.7	4.5		

Table 0.2. *Weights and measures*

Pre-metric weights: pound (*pond*), divided into 32 *loden*

Alkmaar		494 grams
Amsterdam		494
Arnhem		468.8
Brielle		469
Culemborg		469
Delft		468
The Hague		494
Deventer		492
Dordrecht		494
Goes		437.2
Gouda		463
Groningen	to 1701	468 *
	from 1701	492 *
Haarlem		472
’s-Hertogenbosch		471
Kampen		494
Leiden		482
Middelburg		469
Nijmegen		492.2
Utrecht	to 1775	497.8
	from 1775	494
Vlissingen		469
Zaltbommel		468.8
Zierikzee		469
Zutphen		494
Zwolle		503.8

Foreign weights

Antwerp	478
Brussels	470
Cologne	467.7
Copenhagen	496
Hamburg	484.6
Paris	491.4
England	453.6

Metric weight
Kilogram = *Nederlandsche pond* = 1,000 grams

* In 1701 Groninigen shifted from “Cologne weights” to “Troy weights.”

Pre-metric volume measures used in the grain trade:

Amsterdam last: 3,003.9 liters. Some authorities cite 3,010 liters. In this table subsidiary measuring units are identified in two ways: by the number of units per Amsterdam last, and by liter content.

Units	*mud*	*zak* (sack)	*schepel* (bushel) or *achel*
Amsterdam: per last	27	36	108
liters	111.5	83.5	27.9
Alkmaar	same as Amsterdam		
Arnhem	22		88
	136.8		34.2
Brielle		39	
		77.85	
Delft		29	87
		103.8	34.6
The Hague		28	84
		107.5	35.8
Deventer	26		104
	115.5		28.9
Dordrecht	24 (*vaten*)	32	96
	125.4	93.9	31.3
Friesland	24	36 (*lopen*)	
	125.4	83.5	
Goes		37.5	75
		79.8	39.9
Gouda		28	
		107.5	
Groningen	33	36	
	91.2	83.6	
Haarlem		38	76
		79.1	39.6
Kampen	same as Amsterdam		
Leiden		44	88

		68.4	34.2
Middelburg		41.5	83 (*halve zak*)
		72.5	36.75
Nijmegen	18		72
	167.2		41.8
Utrecht	25		100
	120.4		30.1
Zaltbommel		36	72
		83.8	41.9
Zutphen	18		
	167.2		
Zwolle	same as Utrecht		

Medieval grain measures:

		hoed	*zak*	*achtendeel*
Delft	per *hoed*		10.67	32
	liters	1107.2 l.	103.8	34.6
Leiden			16	32
		1094.4	68.4	34.2
Haarlem				32
		1161.6		36.3

Foreign volume measures:

Antwerp	*viertel*	79.6 l.	(37.5 = l last)
Brussels	*sister*	48.7 l.	(60 = 1 last)
Bruges	*hoed*	160.2 l.	(18.75 = 1 last)
Ghent	*mud*	913.4 l.	
	12 *halster* = 6 *zakke* = 1 Ghent *mud*		
Cologne	*malter*:	143.5 l.	
Copenhagen	*Tonde*:	139.1 l.	
Paris	*setier*	156.1 l.	
	12 *setier* = 1 Paris *muid*		
England	Winchester quarter =	281.9 l.	
	10 quarters = “English grain last” = 2819 l.		
	8 bushels (35.238 l.) = 1 quarter		

31 Winchester quarters = 30 imperial quarters

Metric volume measures:

last = 30 *mud* = 3000 l.
mud = hectoliter = 100 l.

Sources: J. M. Verhoeff, *De oude Nederlandse maten en gewichten* (Amsterdam: P. J. Meertens-Instituut, 1982).
W. C. H. Staring, *De binnen- en buitenlandsche maten, gewichten en munten van vroeger en tegenwoordig* (1902), 4th revised and supplemented edition (Arnhem: Gybers en van Loon, 1980).
G. J. C. Nipper, *Meten en wegen in de Lage Landen* (Zutphen: Walburg Pers, 2004).
J. H. van Swinden, *Vergelijkings-tafels tusschen de Hollandsche koorn-maten en de hectoliter met het nodige onderright over dezelve maten* (Amsterdam, 1812).
C. F. Eversdijck, *Paste-boeck vanden Broode* (Middelburg, 1663).
Marie-Jeanne Tits-Dieuaide, *La formation des prix céréaliers en Brabant et en Flandre au XVe siècle* (Brussels: Éditions de l'Université de Bruxelles, 1975).
Paul Vandewalle, *Oude maten, gewichten, en muntstelsels in Vlaanderen, Brabant, en Limburg* (Ghent, 1984).

Data from these and other sources are summarized in "De oude Nederlandse maten en gewichten": www.meertens.knaw.nl/mgw/.