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Variations in the price and quality of English grain, 1750–1914: Quantitative evidence and empirical implications☆

Liam Brunt[a], Edmund Cannon[b,*]

[a] Department of Economics, NHH, Norwegian School of Economics, Helleveien 30, 5045 Bergen, Norway
[b] Department of Economics, University of Bristol, 8 Woodland Road, Bristol BS8 1TN, United Kingdom

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Abstract

Interpretation of historic grain price data may be hazardous owing to systematic grain quality variation — both cross sectionally and over varying time horizons (intra-year, inter-year, long run). We use the English wheat market, 1750–1914, as an example to quantify this issue. First, we show that bushel weight approximates grain quality. Then we show that cross sectional and intra-year variation are substantial and problematic, generating erroneous inference regarding market integration. Long run variation is significant, due to sharply declining international quality differentials, and this impacts estimated cost of living changes. By contrast, inter-year variation is smaller and controlled for more easily.

Keywords: Grain quality; Measurement error; Markets; Cost of living
JEL classification: N01; N50; Q13

1. Introduction

We address the issue of quality variation, which we shall quantify for wheat, the primary Western European food grain since 1800 (Collins, 1993). We discuss consequences of quality variation for both market participants and historians interpreting price and quantity data, focusing on the issue of interpretation by historians.

As a widely available historical source, grain prices have been used to quantify living standards (Phelps Brown and Hopkins, 1956), market integration (Shiue and Keller, 2007) demand elasticity (Fogel, 1992), interest rates (McCloskey and Nash, 1984) and even cognitive ability (Baten, Crayen and Voth, 2014). These studies rely on the fact that wheat used to contribute a large share of household budgets and caloric intake (Feinstein, 1998) and shortages of grain led to famine as

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* Corresponding author.
E-mail addresses: liam.brunt@nhh.no (L. Brunt), edmund.cannon@bristol.ac.uk (E. Cannon).

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recently as 1891–2 in Russia. With so many wheat prices being used, it is important to know how much quality variation matters, e.g. Brunt and Cannon (2013) argue substantial and systematic pre-1914 wheat quality variation makes price movement interpretation difficult.

Quality variation is frequently acknowledged in economic history but rarely studied explicitly. Olmstead and Rhode (2003) study post-1920 US cotton quality improvements, particularly via the quality metric of staple length. But they really focus on governmental and economic institutions to facilitate raising quality, rather than implications of quality measurement and implications for price variation. Olmstead and Rhode (2002) study exhaustively US wheat seed variety ("cultivar") changes, 1840–1940, showing how changing cultivars enabled wheat production to spread to harsher US climates and maintained yields in the face of crop pests. Again, this differs from our focus on interpreting historical data.

Within the English market, merchants determined quality by inspection, at purchase and delivery. Increasing mid-19th century international trade required organizations (Chicago Board of Trade, London Corn Trade Association) enabled traders to establish quality remotely (Velkar, 2012). Reliable long-distance transmission of quality information was crucial for modern milling techniques. But wheat quality information remained problematic for some imports even in the late 19th century — notably Indian, as evidenced by the Secretary of State of India's 1885–90 enquiry (BPP, 1894).

In this study of English quality variation 1750–1914, we begin with definitions and contemporary information on domestic wheat in different locations (Section 2) and of different types (Section 3). In Section 4 we discuss trends in quality of imported wheat. Section 5 uses our estimates of quality variation and simulation analysis to see the effects on time-series analyses of prices. Section 6 looks at the inter-year variation and section 7 discusses the within-year variation. Overall, we find substantial spatial and long-run quality variation; measurable but modest inter-year variation; little *systematic* intra-year quality variation for wheat (rather more for barley and oats).

2. Grain quality

Although we focus on England, we provide an historical benchmark where quality is directly measured — late 19th century USA. The Chicago Board of Trade developed a wheat grading system to facilitate exports, culminating in the 1916 US Grain Standards Act (Hill, 1990). Long distance trade (Chicago to New York, thence Europe) necessitated explicit grain quality measures to create homogeneity and transparency (Henry and Kettlewell, 1996). Each wheat type was subdivided into six grades (Grade 1 at the top, down to Grade 5, to "Sample Grade" at the bottom). Grades were based on bushel weight, moisture content, percentage of damaged kernels, purity, cleanliness and condition (Ball et al., 1921).

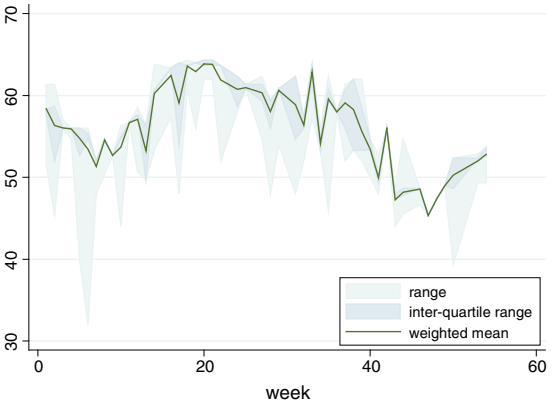

Fig. 1. Bristol weekly wheat prices, 1790.

US price data for this period are constant-quality, sometimes available for several grades. With some variation, Grade 2 wheat traded at a 5% discount to Grade 1, a 12% premium to Grade 3. Proportions of each grade shipped Chicago–New York show great year-on-year variation: 1% was Grade 1 in 1879, 11% in 1878 (Chicago Board of Trade annual reports — see appendix A1). Using prices and proportions of each quality, we construct an average-quality index to quantify annual quality volatility for 31 years (1875–1912, 7 years missing).

To fix concepts and notation, consider the following price model, where the quality traded changes over time. At time t, observed average market price is P_t, dependent on the average quality traded at time t. Define P_t^* as the market price if average quality at time t were actually constant over the whole time sample: notice that P_t^* changes over time due to shifts in supply and demand. Then

$$P_t = P_t^* H_t \Rightarrow \ln P_t = \ln P_t^* + \eta_t \quad (1)$$

where $\eta_t \equiv \ln H_t$ is the effect of quality on price. Throughout this paper we use the standard deviation of log variables (similar to the coefficient of variation) as our volatility measure. For US wheat, 1871-96, where we observe both prices and quantities of different

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