

The Welfare Impact of a New Good: The Printed Book

Jeremiah Dittmar*

Version 0.2 – Very Preliminary Draft

May 27, 2011

Abstract

Gutenberg’s printing press was the great revolution in Renaissance information technology. Economists have struggled to identify its impact in macroeconomic data on productivity, output per person, or real wages. This paper documents the welfare impact of the technology by exploiting data on the price and consumption of books in England between the 1490 and 1700. I find that the welfare impact of the printed book was equivalent to 4% of income by the 1540s and 10% of income by 1700 using a calibration strategy. The impact of the Gutenberg revolution exceeded similarly measured welfare effects so far associated with the personal computer. Moreover, in historical perspective the share of spending devoted to print media was relatively low, implying that the printed book had a relatively big “bang for the buck” in delivering felicity.

Keywords: Information Technology, Welfare, Print Media, History.

JEL Classification: N13, N33, N93, O11, O18, O33

*Department of Economics, American University, 4400 Massachusetts Avenue NW, Washington, DC 20016. Email: dittmar.academic@gmail.com. Web: www.jeremiahdittmar.com. I thank Mary Hansen, Noel Johnson, John Nye, and Karen Kopecky for discussion and seminar participants at UC Davis, UC Berkeley, Universiteit Utrecht, and the Washington Area Economic History Workshop for their comments. I thank Kevin McGee for research assistance. The National Science Foundation provided support for the research. The errors are mine.

1 Introduction

Gutenberg’s printing press was the great revolution in Renaissance information technology. Historians argue that the printing press was one of the most important innovations in human history (Braudel 1979; Eisenstein 1979; Gilmore 1952). Roberts (1996, p. 220) suggests the outcome was one, “dwarfing in scale anything which had occurred since the invention of writing.”

Economists have struggled to identify the impact of the printing press in macroeconomic data on productivity, output per person, or real wages. The printing press thus joins contemporary innovations in information technology in posing a puzzle for economics. Both the printing press and recent innovations in computing have been heralded as world historical revolutions. Both have been associated with limited improvements in conventional measures of macroeconomic performance. Both carry a “productivity puzzle.”

This paper documents the welfare impact of the Renaissance information technology by exploiting data on the price and consumption of printed books in England between the 1490s and 1700. I find that the welfare impact of the printed book was equivalent to 4% of income by the 1540s and 10% of income by the mid-1600s using a calibration strategy. By comparison, the same approach indicates that the welfare impact of the personal computer was no more than 3% of income as of 2004. However, the share of consumer spending devoted to print media was both absolutely and relatively very small. Relative to expenditure, spending on print media had extremely large utility payoffs when compared to spending on other notable new goods in economic history, including the personal computer.

These findings yield two principal insights. The first is that the Gutenberg revolution had a large positive impact on living standards in pre-industrial England. This positive impact on living standards is not well accounted for by conventional measures of real wages or aggregate productivity. Moreover, the positive impact on living standards grew over time, implying greater economic dynamism in pre-industrial England than conventional real wage or productivity measures suggest.

The second insight is that, while the welfare impact of the printed books exceeds the effects so far associated with innovations in information technology, the print media revolution has something important in common with recent IT revolutions. In both cases, total factor productivity calculations may miss important aspects of technological change. Where goods are radical innovations whose prices fall dramatically, small expenditure shares can be associated with very substantial increases in felicity.

2 Historical Background

Before the printing press, books were extremely rare luxuries typically owned only by well-endowed educational and religious institutions or the super-rich. The printing press dramatically lowered the price of books. Following the advent of printing, books went from being luxuries to, “diverse, popular, and generally available commodities.” (Raven 2007, p. 9).

Before the diffusion of movable type, manuscripts were very expensive. For example, in 1383 a scribe was commissioned to write a single missal (service book) for the bishop of Westminster. For this work, the scribe was paid £4, a sum equivalent to 208 days’ wages for a skilled craftsman.¹ Over the manuscript era, books were sufficiently rare and valuable that they were used as collateral on substantial cash loans extended to scholars by Oxford and Cambridge universities.² In this era, university libraries employed chains to lock down and protect their precious volumes from theft.

The printing press transformed the conditions under which texts were produced and circulated. Movable type printing was invented in Mainz, Germany around 1450. Over the late 1400s and early 1500s, the technology diffused from Mainz to cities across Europe (Dittmar 2011). The first records of printed book purchases by English citizens date from the late 1460s (Armstrong 1979). William Caxton printed the first book in English in Bruges in 1473 and set up the first printing press in England in 1476 (Clair 1979). The number of establishments grew steadily. In 1495, 18 book titles were produced in England. By 1545, there were 15 printing establishments in England and the number of titles printed rose to 119. By 1695, some 70 printing establishments produced 2,092 titles.³

The printing press was associated with dramatic reductions in the cost of texts. In the decades following the introduction of printing, the cost of books fell by approximately 80% (Bell 1937; Clark 2004). The price reductions were driven by several factors. Before the printing press, documents were written and copied by hand by relatively expensive scribal labor. The new technology made possible the relatively efficient reproduction of multiple copies of a given text (Febvre and Martin 1958; Nedermeyer 1989; Eisenstein 1979). The printing press also made possible extensions of the division of labor in the

¹The £4 fee was simply for the writing. The costs of illustration, binding, and paper are listed separately. The scribe performing the transcription worked part time and completed the project over the course of two years. See Bell (1937) and Schramm (1933). Clark (2005) reports wages for skilled craftsmen in the 1380s as 4.62 pence per day. Historically, there were 240 pence in £1.

²After 1500, with the widespread availability of cheap printed texts, this practice eroded (Bell 1937).

³Figures on titles printed from the *English Short Title Catalogue* (British Library 2011). See section 3 for discussion of these data. Data on the number of establishments are from Raven (2007), p. 47.

production of texts. Printing presses employed master printers, copyists, typesetters, and apprentices and were one of the earliest examples of mass production (Febvre and Martin 1958).

The printing press was also associated with innovations in the format and quality of written texts. Paper typically accounted for around 40% of the cost of print media (Pollard 1941*). Between 1500-1540, printers adopted new fonts and layouts that allowed them to increase the numbers of letters per page by 50%. Other innovations included the development and diffusion of the title page. Prior to the advent of printing, books were so rare that a page telling a buyer at a glance about the subject and the author was not necessary (Hirsch 1965, p. 72). Similarly, as the quantity of books exploded finding aids and innovations organizing printed texts were adopted. In the late 1400s, almost no books had page numbers. By the late 1500s, over 90% of books used printed numbering on pages (Smith 1988).⁴ Along with page numbers, the index was another innovation that came with the emergence of print media.

England's printing industry was, in its first decades, subject to greater regulation than the printing industry in other European economies. England's book-craft guild was originally organized in 1403 and known as the Mystery of Stationers. In 1557, this organization was awarded a royal charter and became known as the Company of Stationers (Christianson 1987; Pollard 1939). In addition to printing establishments licensed through the Company of Stationers, printing was carried on by the King's Printer and at Cambridge and Oxford. Government regulation placed significant limits on entry and foreign competition in the English book market (Raven 2007).

This institutional regime was overthrown, and the production of print media transformed, with the English Revolution of the 1640s. In 1640, the existing controls on the press collapsed as England entered a period of social upheaval and institutional change. From 1640 forward, England witnessed an explosion of new book titles and the emergence of new genres – notably serials and early news journals (Peacey 2004; Raven 2007; Mendle 1995).

From the outset the printed book was celebrated and valued as a vehicle for practical knowledge, diversion, and above all as a means to access the divine. The bible was the great best-seller of the first century of print in England. Over the period 1500-1700, literacy and access to a broad variety of books increased dramatically. By the late 1600s, the literacy rate for men was at least 45% and perhaps as high as 70%.⁵

⁴Numbering of pages developed over the middle ages – before printing. But the practice was widely adopted only in the print era.

⁵Cressy (1980) estimates that literacy rates in the late 1600s were over 40% and 30% for men and

Popular literature was sold by thousands of licensed vendors in every English county. For instance, in the 1640s over 300,000 popular almanacs were sold annually – enough for one in three households to buy an almanac each year. These almanacs were typically 45-50 pages long and sold for 2 pence, at a time when the daily wage for unskilled labor was 11.5 pence.⁶

Section 6 (below) provides a more extensive discussion of the social history, the diffusion, and availability of print media. Section 6 further documents the reasons why printed matter had very large welfare effects.

3 Methodology: Assessing the Welfare Impact of a New Good

3.1 Motivation

To identify the welfare impact of the printed book we must know what utility was with the book and what utility would have been in its absence. This section describes the methods used to identify the welfare impact. These methods address two counterfactual questions. The first counterfactual imagines a consumer living in 1635 (or 1695) in a world without printed books. The question is: How much additional income would this consumer require to secure welfare equivalent to what she actually had in the world with books? (This is the equivalent variation measure of the welfare impact.) The second counterfactual takes an actual consumer living in a period in which printed books were available. Here the question is: How much income would have to be taken from the consumer to give him the level of felicity he'd have absent the printed book? (This is the compensating variation measure of the impact.)

Consumer theory provides a means to answer these questions. However, the economist's conventional isoelastic utility function presents a problem when we examine a situation in which new goods enter the market. With isoelastic utility, marginal utility is infinitely large – and utility is infinitely negative – when consumption is zero.⁷ In the face of reason

women, respectively. These estimates are based on evidence concerning individuals' ability to sign their names. However, in early modern England reading was taught before writing and many people who were unable to sign could read. As a result most historians conclude that Cressy's estimates are significant underestimates of the true ability to read. See Schofield (1979), Fox (2000), and Hackel (2004).

⁶Blagden (1958) reports data on the prices and sales volumes of almanacs in the 1640s. Data on wages are from Clark (2005). Data on the length of almanacs from *Early English Books Online*. Almanacs and popular literacy are discussed in more detail below.

⁷Suppose utility is driven by consumption of a composite "old" good (c) and consumption of the "new"

and evidence, this implies that the welfare impacts of new goods are uniformly infinite.

To estimate the welfare impact of a new good, this paper adopts an “almost conventional” model of consumer demand that bounds utility and marginal utility when consumption of the new good is zero. The theoretical model and empirical approach are from Greenwood and Kopecky (2011).⁸

The model can be used to calculate the welfare impact of the new good in a two step procedure. First, we can bring data on prices and quantities consumed to the model and fit (calibrate) the preference parameters from the utility function. Second, we can use the fitted preference parameters to compute the welfare impact of the printed book at different points in time. After discussing the theoretical model, I conclude this section with a discussion of alternate methods used to estimate the welfare impact of new goods. The data used in the analysis are discussed in section 4 below.

3.2 Theory and Calibration

The theoretical framework is as follows. Assume that people derive utility from consuming an existing composite good (c) and the exciting new good (n). As a baseline assume also that utility takes the form⁹:

$$U(c, n) = \theta u(c) + (1 - \theta)v(n)$$

With:

$$u(c) = \frac{c^{1-\rho}}{1-\rho} \quad v(n) = \frac{(n+x)^{1-\rho}}{1-\rho} \quad \rho \geq 0, x \in (0, \infty)$$

The innovation that makes this model of utility “almost conventional” is the parameter x . This parameter bounds utility and marginal utility when the consumption of printed books is zero. Since marginal utility is always finite, where prices are sufficiently high we can have a solution to the model in which zero books are consumed. For high levels of spending, the preference parameter θ is approximately the share of spending devoted to the old good and $1 - \theta$ is the expenditure share devoted to books.

good (n) and that $U(c, n) = U(u(c), v(n))$. We have trouble with things like: $v(n) = n^{1-\rho}/(1-\rho)$, $\rho \geq 0$.

⁸This paper is not the first one to apply the Greenwood-Kopecky approach to historical data. That distinction goes to Hersch and Voth (2009, 2011), who have used the model to examine the welfare impact of new colonial goods on English consumers. Their analysis documents the welfare gains associated with tea, sugar, and coffee.

⁹In the empirical work below, I discuss alternate functional specifications. In particular, I consider utility functions where there are different elasticities of demand for the new and the old good, and functions where felicity derived from the new and the old good are not additively separable. The empirical results are robust to a range of assumptions along these lines.

Agents maximize by choosing quantities:

$$\max_{c,n} U(c, n)$$

Maximization occurs subject to constraints. We assume that consumption of both goods is non-negative and, for simplicity, that all income is consumed in each period. The old composite is the numeraire. The new good has a price p . Income is denoted y . Hence:

$$c + np = y \quad \text{and} \quad c, n \geq 0$$

The maximization problem yields several interesting results.¹⁰ First, there is a price threshold for the new good. Above the threshold price there is no demand for the new good (all expenditure falls on the old composite bundle). Second, the price threshold rises in income. This implies that – along falling price path characteristic of new goods – the rich buy the new product before the poor. Questions surrounding the heterogeneity of agents and the distribution of print media consumption and welfare gains across social groups are discussed at greater length in sections 5 and 6.

The solution to the maximization problem determines the demand functions for the new and old goods along with the threshold price above which printed books are not consumed. The price threshold is:

$$\hat{P}(y) = \frac{1 - \theta}{\theta} x^{-\rho} y^\rho$$

The demand for new good is:

$$n(y, p) = \begin{cases} 0, & \text{if } p \geq \hat{P}(y) \\ \frac{y+px}{p+[(1-\theta)/\theta]^{-1/\rho} p^{1/\rho}} - x, & \text{if } p < \hat{P}(y) \end{cases} \quad (1)$$

Demand for old composite consumption bundle is:

$$c(y, p) = \begin{cases} y, & \text{if } p \geq \hat{P}(y) \\ \frac{y+px}{1+[(1-\theta)/\theta]^{1/\rho} p^{(\rho-1)/\rho}}, & \text{if } p < \hat{P}(y) \end{cases} \quad (2)$$

To conduct welfare analysis we require knowledge of the parameters in the utility function. This paper exploits historical data to recover these parameters. The historical data describe the quantity of books consumed, the price of books, and incomes. The

¹⁰Greenwood and Kopecky (2011) provide more detained discussion and derivations.

calibration recovers the parameters in the utility function by minimizing the distance between the observed consumption of books and the times series predicted by equation (1).

$$\min_{\rho, \theta, x} \sum_{t=1}^T [n_t - \mathbf{n}(\rho, \theta, x; y_t, p_t)]^2$$

To calculate the welfare impact of the book, consider welfare W to be a function of income and relative prices: $W(y, p)$. The equivalent variation measure of the welfare impact of the book is β_{EV} such that a consumer would be indifferent between consuming $(1 + \beta_{EV})y_t$ of the composite good and no books, and the one hand, and the actually observed consumption bundle (c_t, n_t) on the other, where t indexes the time period.

$$\beta_{EV} = \frac{[(1 - \rho)W(y_t, p_t) - (1 - \theta)x^{1-\rho}]^{\frac{1}{1-\rho}}}{\theta^{\frac{1}{1-\rho}} y_t} - 1$$

The compensating variation measure of the welfare impact (β_{CV}) measures the amount of income a consumer in a world with affordable books would need to sacrifice in any period to obtain welfare equal to the level available with the same income but no access to printed books. Formally, the compensating variation is defined implicitly by¹¹:

$$\beta_{CV} : W([1 - \beta_{CV}]y_t, p_t) = W(y_t, \infty)$$

3.3 Alternate Approaches

Several alternate approaches that exploit data on expenditure shares to measure welfare gains have been proposed in the literature on information technology. Hausman's (1999) lower bound employs a linear approximation to demand to estimate consumer surplus.

$$\lambda_{CV} = -\frac{1}{2} \cdot \frac{\text{Expenditure Share}}{\text{Elasticity of Demand}}$$

Another approach exploits a Tornqvist price index. If we assume the expenditure function is translog and take prices and expenditure shares at the beginning (0) and end (T) of our study window to be p_0, p_T, s_0 and s_T , respectively. Then Tornqvist equivalent variation is:

$$\lambda_{EV} = \frac{1}{(p_T/p_0)^{(s_T+s_0)/2}} - 1$$

¹¹We operationalize no access to the printed book by imagining an infinite price.

Similarly, Tornqvist compensating variation is:

$$\lambda_{CV} = 1 - (p_T/p_0)^{(s_T+s_0)/2}$$

It is hard to exploit these methods in the case of print media because systematic data on expenditures devoted to books is not available. However, as shown below, the Greenwood-Kopecky approach estimates expenditure shares of 0.15% in the 1540s and 0.57% in the 1690s. By comparison, in 2004 the expenditure share for personal computers in the USA was 0.6%.

Because the Hausman and Tornqvist approaches rely on expenditure shares, they tend suggest relatively small welfare effects for new goods such as computers and books: on the order of 0.5%. While we cannot reject these magnitudes out of hand, the social history literature discussed in section 6 documents that books were extremely important for utility, despite their small expenditure shares in English budgets. In a similar vein, Goolsbee and Klenow (2006) find notable welfare gains associated with internet access despite the relatively small share of spending devoted to it.

4 Data

This section describes the data. First, it describes the data on the quantities of books produced and consumed in England. Then it describes data on the price of books. Finally, it describes data on incomes and broad consumer price indices.

Data on the Quantities of Books

The key data on the production of books are from the *English Short Title Catalog* or ESTC (2011). The ESTC catalogues all known books printed in England 1467-1800.¹² Each observation records what modern bibliography would describe as an edition: A printing in a given year. Several additional sources and methods are employed to generate series for annual book consumption. Figures 1 and 3 below document the quantity data.

Two principal questions must be addressed to estimate book consumption. The first

¹²The ESTC is designed as a union catalogue of books, pamphlets and other ephemeral material printed in English-speaking countries printed before 1801. I restrict the data to books published in England. The overwhelming majority of items in the ESTC are recognizably books: larger, bound printed items. However, the ESTC also contains data on a number of pamphlets, booklets, and serials. The ESTC only contains a small proportion of the historically consumption of pamphlets and ephemera. For instance, for the period 1641-1700 the ESTC records roughly 5,000 serials and 94,200 total items. The fact that serials and pamphlets are largely excluded from the database implies that the estimated welfare effects will be biased down.

concerns changes over time in the number of books printed in given edition. The second concerns the import and export of books. However, the big picture conclusions of this paper are not contingent on the particular way one accounts for either variations in the size of print runs or the role of imports and exports.

The empirical work below adopts two approaches to describe domestic print output. As a baseline, I treat the edition as the unit of analysis so that the number of editions in each year is treated as the number of books. From the perspective of estimating welfare effects, this approach is conservative. As an alternate strategy, one could rely on historical evidence to scale the number of editions by the time-varying size of print runs (i.e. the number of printed copies of each title). Broadly print runs increased over the first 100 years of printing, before stabilizing. Data on the size of prints is available in a variety of historical sources, but remains fragmentary (Hirsch 1967). The available evidence suggest that in the earliest decades of printing, the typical print run was for 200-600 copies (Febvre and Martin 1958; Blayley 1960). By the late 16th century print runs of 600-900 books were common. Throughout the 17th century, print runs of about 1,000 volumes appear to have been typical (Fox 2000, p. 14). Figure 1 below compares data on observed book editions and estimates of total physical volumes based on the historical evidence on the size of print runs.

English book consumption included imported books (Needham 2002). Evidence from trade fairs suggests that the ratio of net imports to domestic production was initially large and positive in the late 1400s, and that by the later 1600s British book consumption was essentially met with domestic supply. Buringh and van Zanden (2010) provide estimates of net imports at 50 intervals. They estimate that net imports were approximately 1.40 times domestic production in 1450-1499, 0.16 times domestic production 1550-1599, and that trade was balanced from 1700 forward. Year-by-year records of imports and exports are not available.¹³ In the baseline analysis, I rely on the Buringh and van Zanden data to construct a series for domestic consumption net trade. However, the big picture conclusions regarding the welfare impact of the book are not contingent on the particular manner in which we account for trade.

Data on the Prices of Books

Data on the prices of books come from several sources. The paper employs the standardized index of the price of text from Clark (2004) as its principal series for book prices. This index is designed to capture the quality adjusted cost of a standardized 100 pages of text 1200-1800. The index is based on 3,902 observations. The Clark (2004)

¹³Where they exist, customs records often simply record the fact that books entered England, not the specific number of volumes. Data on exports is more fragmentary. See Needham (2002).

index shows the real price of books in England falling 75% between the late 1400s and 1520 and over 90% from the late 1400s to the late 1500s.¹⁴

The price declines recorded in the Clark data are supported a range of evidence on the pricing and production of books in England. The records of the trust that administered London bridge (the Bridge House Estates) are a leading source of evidence on the English book trade before and over the transition to the era of printing.¹⁵ The accounts reveal two things. First, printed books show up in expense reports starting in the early 1500s.¹⁶ Second, by the early 1530s printed books were approximately 80% cheaper than similar manuscripts from the pre-print age. For example, in 1531 the Bridge House Estates purchased two Antiphoners containing three books and a corresponding legend for £4.08 (£4 and 20 pence). In 1395-6 – before the advent of printing – the Bridge House Estates purchased a similar set of Antiphoners for £24.26 (£24, 5 shilling, and 2 pence).¹⁷ Similarly, the King’s Accounts record purchases of printed books and commissions for printed proclamations appearing in significant numbers only in the first decades of the 1500s.¹⁸

Evidence on the per page price of texts confirms the magnitude of the price declines observed in England between the era of manuscripts and the era of the printing press. Before the advent of printing, texts cost approximately 2 pence per page. By the middle 1600s, 50 page books cost 2 pence. Schram (1933) observes that in the late 1300s the standard price for writing was 2 pence per page or leaf.¹⁹ The accounts of the London Bridge Estates confirm this observation, recording the employment of a copyist charging 1.92 pence per page in 1395. On the eve of the printing revolution, in 1468, the copyist William Ebesham was charging virtually the same rate: 2 pence per page for document

¹⁴Although William Caxton set up the first press in England in the late 1470s, his early output was described as “very rude and barbarous” and far below the quality of continental printing. Clair (1965, p. 18) observes that Caxton introduced signatures and adopted a neater type face under “the stimulus of competition” provided by the entrance of other English printers.

¹⁵Until 1750, London Bridge was the only bridge across the Thames. The Bridge House Estates owned not only valuable commercial property on the bridge itself, but also real estate in other parts of the city. The Bridge House Estates also maintained a chapel and purchased both new books and repair services for the maintenance of its collection.

¹⁶The Bridge House Estates archive records a 1509 payment of £0.13 (2 shillings and 8 pence) to “Rychard Pynson prynter” for processional texts and a similar 1514 purchase of “processyoners in prynte.” See Christianson (1987), p. 17.

¹⁷In both instances, the relevant costs are for text alone. The accounts and prevailing pricing conventions separated the cost of producing text from the costs of illustration, illumination, and binding. See Christianson (1987) and Bell (1937).

¹⁸The Calendar of State Papers of Henry VIII shows a series of payments to the printer Richard Pynson for proclamations, statutes, and commissions relating to taking musters in March and July 1511. See Clair (1965), pp. 34-42.

¹⁹The conventional pricing was 16 pence per quire. The quire was four sheets of parchment folded to make eight “leaves.”

transcriptions.²⁰ By the first decade of the 16th century, the retail prices for romances fell to between 0.22 and 0.43 pence per sheet while textbooks cost 0.5 pence per sheet (Raven 2009, p. 50). By the 1664, 2 pence was the standard price for popular 50 page almanacs.²¹ Additional data on the price of manuscript and printed text in England confirm the magnitude of the price declines (e.g. Bennett (1950), Johnson (1950), and primary sources described in Appendix A).

The price data recorded in Clark (2004) are also consistent with evidence on the pricing of books outside England. Dutch, German, and Italian cities were the leading centers of early printing through the 1500s. Cuijpers (1989) and Van Zanden (2004) collect price data for books in the Netherlands and finds an almost identical pattern of real price declines between the 15th and 18th centuries.²² Alongside Dutch towns, cities in Germany and Italy were early adopters of printing. Hirsch (1967, p. 69) observes that in the earliest experimental years, printed media was competitive with manuscript production and that by 1480 – twenty years after the arrival of printing in these economies – printed books cost 50%-80% less than manuscripts in Italian and German cities.

Data on Consumer Prices and Real Wages

Real wage and consumer price data are from Clark (2004) and Clark (2005). Population data are from Schofield and Wrigley (1989). Other data are described as introduced.

Review of Data

Figure 1 shows normalized price and quantity series for printed books consumed in England through the 1630s. The sharp declines in prices and increases in quantities follow a pattern observed with many new goods including the personal computer. Figure 2 documents this fact by presenting price and quantity data for personal computer consumption in the USA from the National Income and Product Accounts.

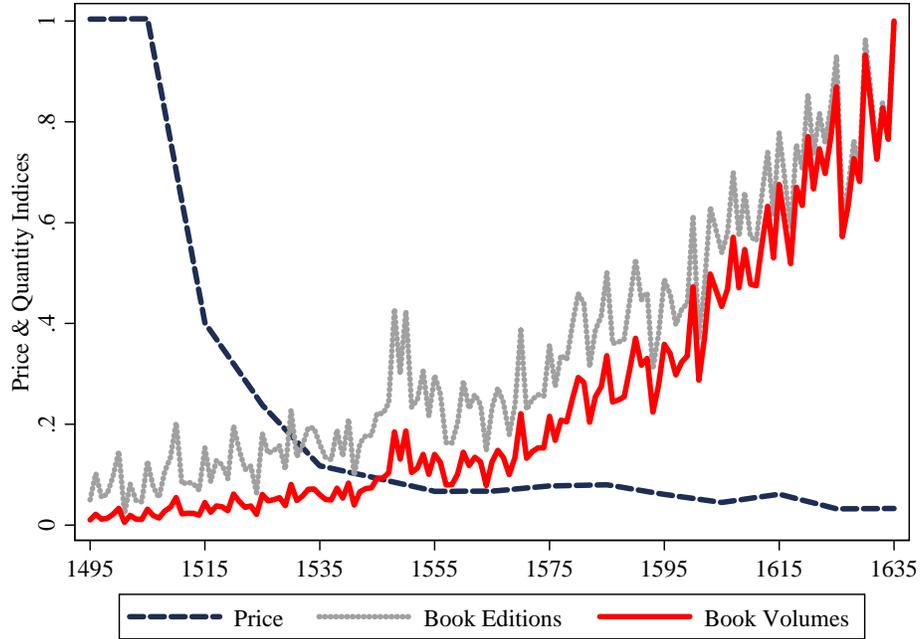
The English Revolution (1640-1660) coincided with changes in the pattern of consumption of print media. Figure 3 documents the explosion of print media that is observed when the regulatory regime governing the printing industry broke down in 1640. Figure 4 shows that, starting in the 1640s, price declines abated but the quantity of books consumed continued to increase.

²⁰The copyist from 1395 charged 2 shillings and 6 pence for each quaternion. See Christianson (1999), p. 132. A quaternion was a bundle comprising 24 sheets of paper and one “outside”. See Glaister (1979).

²¹Blagden (1958) provides data on all 387,800 almanacs sold in the 1664. The mean wholesale value of these books was 1.6 pence. Capp (1979) documents that retail prices were closer to 2 pence. Standard almanacs include the volumes published by Gallen and Cardanus Rider, both of which sold 10,000 copies for just under 2 pence and were 50 pages long. Page counts are from *Early English Books Online*.

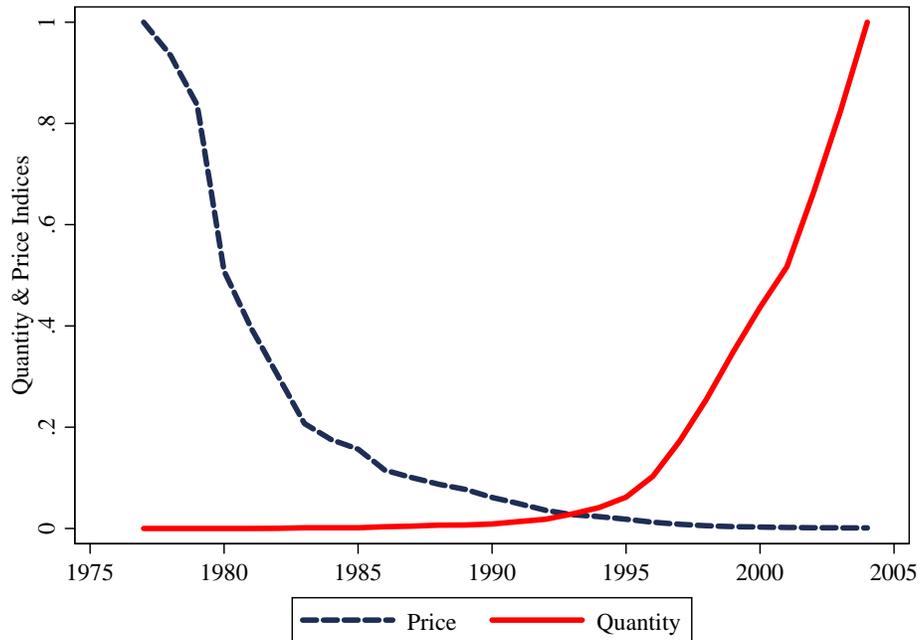
²²Van Zanden (2004, footnote 36) observes: “Clark finds an almost identical decline of real book prices in England between the 15th and 18th century.”

Figure 1: Prices and Quantities of Printed Books 1495-1639



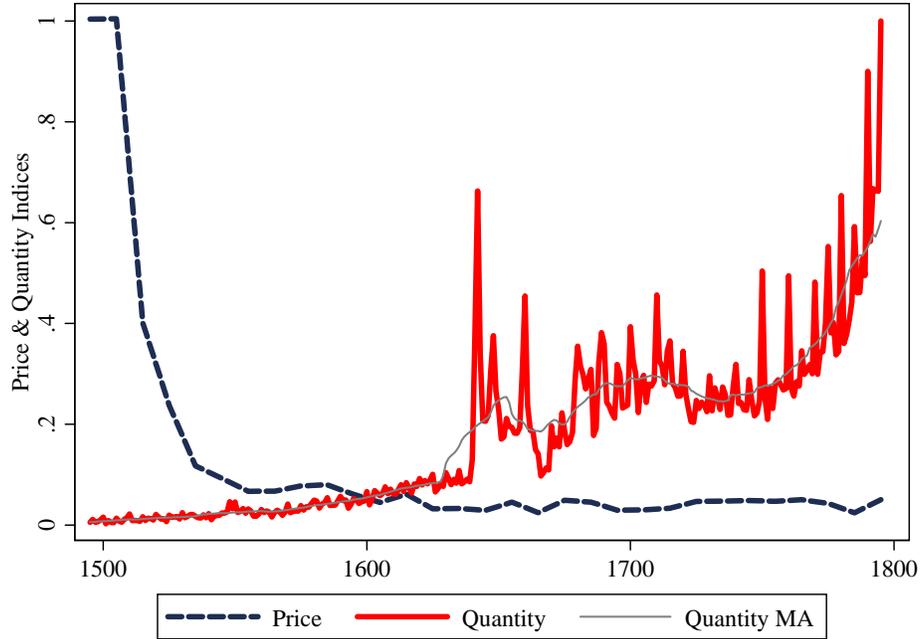
Note: Book editions are individual titles listed in the ESTC. The series is restricted to titles in England and adjusted for imports and exports following Buringh and van Zanden (2010). The series for book volumes is adjusted to reflect the increasing size of print runs of this period. For details see Appendix A. The price series is the normalized real price of 100 pages of text from Clark (2004).

Figure 2: Prices and Quantities of Personal Computers 1977-2004



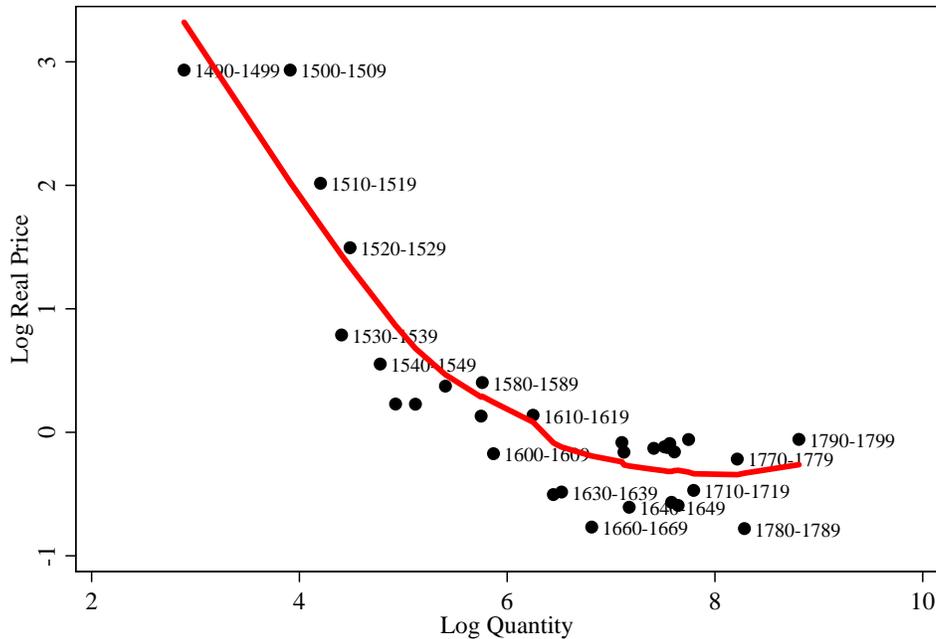
Note: The data are from the BEA National Income and Product Accounts: Table 2.4.4U and Table 2.4.5U.

Figure 3: Prices and Quantities of Printed Books 1495-1799



Note: Book editions are individual titles listed in the ESTC. The series is restricted to titles in England and adjusted for imports and exports following Buringh and van Zanden (2010). The price series is the normalized real price of 100 pages of text from Clark (2004).

Figure 4: Prices and Quantities of Printed Books 1490s-1790s



Note: This graph presents data on book prices and book consumption by decade, along with fitted values from a locally weighted regression.

5 Empirics: The Impact of Printing

This section presents the empirical results. The first step in the analysis is to calibrate the preference parameters governing the demand relationships and utility. The calibration fits preference parameters (θ, ρ, x) to minimize the sum of squared deviations between predicted and observed book consumption over the estimation window.

Figure 5 presents the observed and calibrated series on printed books fitted through the 1630s (up to the English Revolution). Over this period, the model predicts 90% of the variation in consumption. Figure 6 presents similar results calibrated through the 1690s, showing that from the 1640s forward prices and incomes are less successful in predicting consumption. This is consistent with the evidence in the social history literature indicating that this period was one marked by big shifts in ideological and political mobilization that perturbed the demand for print media (e.g. Hill 1975 and Hill 1940). By the later 1600s variations in book consumption were increasingly driven by non-price factors. In particular, increasing literacy and network effects shifted demand over a period when prices were relatively stable.

The second step in the analysis is to calculate the welfare impact of the printed book based on the calibrated preference parameters. Table 1 presents estimates of the welfare impact of the printed book from the 1540s to the 1690s. In terms of current income, the impact climbs from about 5% in the 1540s to over 10% from the 1590s forward. The calibrated expenditure share rises from 0.1% in the 1540s to over 0.5% in the 1690s. This magnitude is very close to the 0.6% expenditure share observed for contemporary purchases of personal computers in the USA.²³ Column (5) shows that the percent of variation explained by the model rises through the 1630s to 90%, but subsequently falls as non-price and non-income determinants of consumption took on greater importance.²⁴

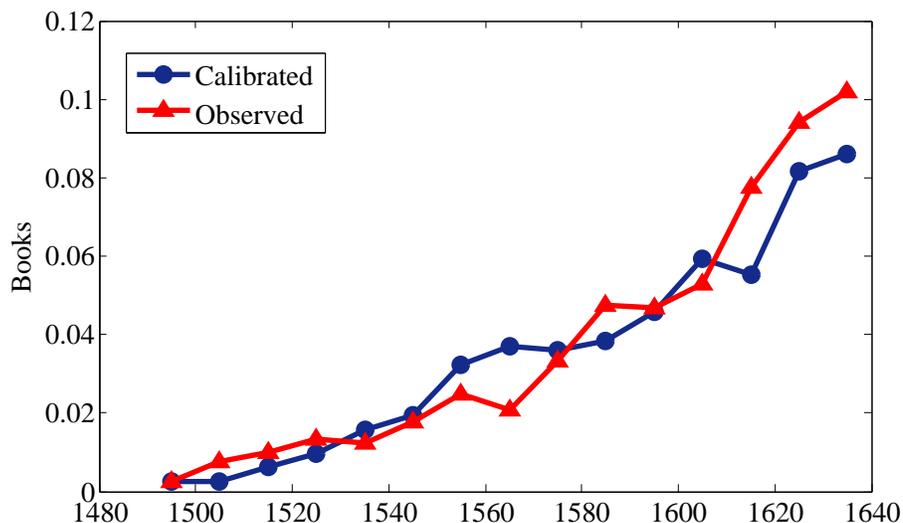
Table 2 compares the welfare impact of the book to similarly estimated effects for a set of important new goods in economic history: the personal computer 1977-2004 and new, stimulating colonial goods (tea, sugar, and coffee) 1600-1850. There are two principal insights to take away from Table 2. The first concerns the magnitudes of the welfare effects. Table 2 shows that roughly half a century into England's printing era the welfare impact of the book exceeded the impact so far associated with the personal computer. By the late 1600s, the printed book had a welfare impact greater than any individual colonial commodity, but less than tea and sugar taken together. The second insight is that both the printed book and the computer delivered relatively large increases in felicity given

²³The 0.6% expenditure share for computers is observed directly in the data and is delivered as a fitted value by the Greenwood-Kopecky calibration.

²⁴As discussed above, the methodology provides point estimates but is silent on standard errors.

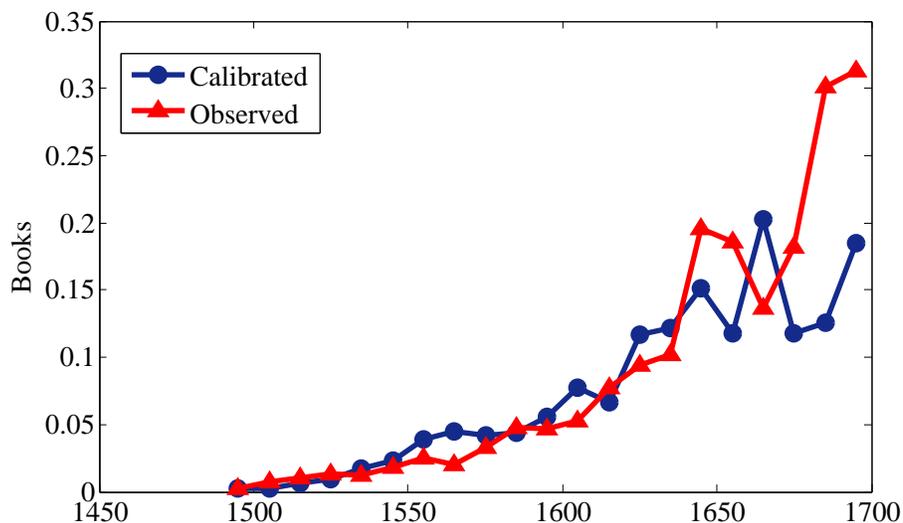
their relatively small share in consumer expenditures. Column (5) presents the ratio of calibrated welfare benefits to expenditure shares. For the colonial products, this ratio is between 1 and 1.5. For the personal computer it is 3.65. For the printed book, the ratio of benefit to expenditure share is 39.25 in the 1540s, falling to 18.77 by the 1690s.

Figure 5: Observed and Calibrated Books 1490s-1630s



Note: This graph shows the observed and calibrated series for book consumption before the English Revolution. The book consumption series are normalized (1790-1799 = 1). The unit of observation for all variables is the decade.

Figure 6: Observed and Calibrated Books 1490s-1690s



Note: This graph shows the observed and calibrated series for book consumption before and after the English Revolution of 1640-1660. The book consumption series are normalized (1790-1799 = 1). The unit of observation is the decade.

Table 1: Welfare Impact of Printed Book

Date	Equivalent Variation	Compensating Variation	Expenditure Share	Quasi R Square
(1)	(2)	(3)	(4)	(5)
1540s	5.12%	4.71%	0.12%	45.75%
1590s	14.50%	10.70%	0.05%	81.91%
1630s	16.08%	12.14%	0.12%	90.13%
1690s	12.30%	10.70%	0.57%	64.05%

Note: This table presents results from the Greenwood-Kopeccky calibration. The expenditure share is the parameter θ . The quasi R-square is the percent of variation explained by the calibration.

Table 2: A Comparison of the Welfare Impacts of Important New Goods

Good	Time Period	Expenditure Share	Welfare Impact	Ratio of Impact to Expenditure
(1)	(2)	(3)	(4)	(5)
The Computer	1977-2004	0.60%	2.19%	3.65
Sugar	1600-1850	5.65%	7.60%	1.35
Tea	1600-1850	4.10%	7.30%	1.78
Coffee	1600-1850	1.25%	1.50%	1.20
The Printed Book	1495-1545	0.12%	4.71%	39.25
The Printed Book	1495-1695	0.57%	10.70%	18.77

Note: This table compares the welfare impact and expenditure shares calculated using the Greenwood-Kopeccky (2011) estimation-calibration methodology. The expenditure share is the share of consumption devoted to the good in question at the end of the estimation-calibration window. The welfare impact is compensating variation: in percentage terms, how much income would have to be taken from a consumer to give him the utility he would have had absent the good in question? (Appendix B provides a similar version of the results for equivalent variations.) Results for the personal computer are from Greenwood and Kopeccky (2011). Results for tea, sugar, and coffee are from Voth and Hersch (2009) and assume a single value for the utility curvature parameter ρ across all colonial goods.

The key parameter driving the results is the parameter that governs the curvature of the utility function (ρ). Where ρ is relatively small, new and old goods are relatively good substitutes; where ρ is large, new and old goods are strongly complementary in delivering utility (Greenwood and Kopeccky 2011). In a constant relative risk aversion set up, $1/\rho$ is the intertemporal elasticity of substitution: large ρ imply low intertemporal elasticities of substitution.

Table 3 presents the key preference parameters for the printed book, the three signal colonial goods examined by Hersch and Voth (sugar, tea, and coffee), and the personal computer. Table 3 shows that the big welfare effects of historic goods – both the delights of the colonies and the printed book – were associated with high values of the utility curvature parameter ρ . In fact, comparing the preference parameters for the book as of

the 1690s and the computer as of the mid-2000s, we find that the estimated expenditure share (θ) and the utility-bounding constant (x) are almost identical. The great difference between is the preference parameter capturing the substitutability between the new good and the existing composite consumption bundle. For, the computer this parameter is relatively small $\rho_{computer} = 0.33$. Greenwood and Kopecky (2011: 15) observe “The value for ρ suggests that computers and general consumption goods are substitutes. This makes sense given that computers and their accessories have substituted for a variety of other goods such as calculators, typewriters, stationary, travel agents, photo albums, etc.” In contrast, $\rho_{book} = 1.25$ when estimated through the 1690s. The magnitude of this estimate captures the fact that pre-existing goods were not ready substitutes for the welfare-enhancing characteristics of the new print media.

Table 3: A Comparison of the Preference Parameters for Important New Goods

Exciting New Good	Curvature of Utility Function	Bounding Parameter	Income Share	Welfare Impact
	(ρ)	(x)	(θ)	(λ)
The Printed Book (1630s)	1.96	0.00	0.1%	12.1%
The Printed Book (1690s)	1.25	0.00	0.6%	10.7%
Sugar from Colonies	0.72	0.10	7.3%	6.2%
Tea from Colonies	1.49	0.06	2.9%	11.3%
The Personal Computer	0.33	0.00	0.6%	2.2%

Note: This table compares the preference parameters calculated using the Greenwood-Kopecky (2011) estimation-calibration methodology. Unlike in Table 2, here the results for sugar, tea, and coffee are calculated with independent utility curvature parameters (ρ).

6 The Social History of Print Media

6.1 Desires for Print Media

The welfare effects of the printed book were tied to what it offered consumers in early modern England. Books provided a wide range of practical knowledge, diversions, and pleasures. But by far the most widely consumed books were religious in nature, and the historical power of religious sentiment was a key determinant of the welfare impact of the printed book.

In early modern England, religious and devotional books offered knowledge, experiences, and teachings that were understood to be essential to human existence. Religious books were understood to equip people for salvation and a life of what contemporaries termed godliness. In the early 1500s, cheap print made religious texts suddenly available

to the broader public and clergy were urged to:

“comfort, exhort, and admonish every man to read the Bible in Latin or English as the very Word of God and the spiritual food of man’s soul.” (quoted in Cressy 1980, p. 3)

These calls were reflected in a great popular enthusiasm for religious media. In the first decades of printing, approximately 40% of books were religious or devotional (Bennett 1952, p. 65). The bible itself was the great best-seller of early modern England. Across income classes, bibles appear in probate records as and away the most commonly owned book (Clark 1979). However, the bible was invariably a relatively expensive volume – a function of its sheer size – and did not exhaust the market for religious material. Alongside the bible, English consumers purchased enormous quantities of cheap religious ballads, broadsheets, and “chapbooks” (Spufford 1981; Watt 1991). For instance, devotional chapbooks retailed for around 2 pence in the mid-1600s, when the daily wage for an unskilled worker ranged between 9 and 11 pence (Clark 2005; Watt 1991).

In addition to access to the divine, books offered an impressive array of useful knowledge. Books provided crucial instruction for students, scholars, lawyers, and administrators. Books also provided useful knowledge for farmers (Sullivan 1981) and merchants (Hooek 2008). Almanacs provide an interesting example of the diffusion and popularization of practical knowledge. As discussed below, almanacs sold in massive numbers: enough were sold for 1 in 3 households to purchase an almanac in each year (see Blagden 1958). Rider Cardanus’ 50 page almanac of 1664 sold 10,000 copies at just under 2 pence each and is a representative example of the genre. Following the title page, the almanac begins with a heuristic table of wages and expenses (page 2) and a table for calculating interest rates (page 3). See Figure 7.

Figure 7: The First Pages of Rider Cardanus' 1664 Atlas

A Table of Expenses and Wages

By the wee			Moneth			Year		
sh.	d.	q.	sh.	d.	q.	sh.	d.	q.
10	0	7	0	2	4	1	10	5
20	1	2	0	4	8	3	0	10
30	1	9	0	7	0	4	11	3
40	2	4	0	9	4	6	1	8
50	2	11	0	11	8	7	12	1
60	3	6	0	11	0	9	2	6
70	4	1	0	16	4	10	12	11
80	4	8	0	18	8	12	3	4
90	5	3	1	1	1	13	13	9
100	5	10	1	3	4	15	4	2
110	6	5	1	5	8	12	14	0
10	7	0	1	8	0	18	5	0
20	14	0	2	16	0	36	10	0
30	1	0	4	4	0	54	15	0
40	8	0	5	12	0	72	0	0
50	15	0	7	0	0	90	5	0
60	2	0	8	8	0	108	10	0
70	9	0	9	16	0	127	15	0
80	12	0	11	4	0	146	0	0
90	3	0	12	12	0	164	5	0
100	10	0	14	0	0	182	10	0
110	17	0	15	8	0	200	15	0
120	4	6	16	15	0	219	0	0
130	11	0	18	4	0	237	5	0
140	18	0	19	12	0	255	10	0
150	5	0	21	0	0	273	15	0
160	12	0	22	8	0	292	0	0
170	19	0	23	16	0	310	5	0
180	6	0	25	4	0	328	10	0
190	13	0	26	12	0	346	15	0
200	0	0	28	0	0	365	0	0

plain and easie Table; shewing the true Interest due upon any Sum of money, from 5 shillings to an hundred pounds, after the rate of 6 pounds in the hundred.

Shill.	1 Mon		3 Mon		6 Mon		9 Mon		A year	
	sh.	p.	sh.	p.	sh.	p.	sh.	p.	sh.	p.
5	0	0	1	0	2	0	3	0	4	0
10	0	0	2	0	4	0	6	0	8	0
15	0	0	3	0	6	0	9	0	12	0
20	0	0	4	0	8	0	12	0	16	0
25	0	0	5	0	10	0	15	0	20	0
30	0	0	6	0	12	0	18	0	24	0
35	0	0	7	0	14	0	21	0	28	0
40	0	0	8	0	16	0	24	0	32	0
45	0	0	9	0	18	0	27	0	36	0
50	0	0	10	0	20	0	30	0	40	0
55	0	0	11	0	22	0	33	0	44	0
60	0	0	12	0	24	0	36	0	48	0
65	0	0	13	0	26	0	39	0	52	0
70	0	0	14	0	28	0	42	0	56	0
75	0	0	15	0	30	0	45	0	60	0
80	0	0	16	0	32	0	48	0	64	0
85	0	0	17	0	34	0	51	0	68	0
90	0	0	18	0	36	0	54	0	72	0
95	0	0	19	0	38	0	57	0	76	0
100	0	0	20	0	40	0	60	0	80	0

The use of this Table is this, If thou wouldst know what the Interest of one hundred and five pounds is for nine months, at 6 per Cent. then in the first column find out 100 at the foot of the column, and right against it, under the title 9 mon. (which is the fifth column) there you shall find 41. 10s. and against the number 51. you shall find 4s. 6d. so that the Interest of 104. l. for 9 mon. cometh to 41. 14s. 6d. the like of all the rest.

Note: *Early English Books Online*. The legend for the table at right reads: "The use of this Table is this, If thou wouldst know what the Interest of one hundred and five pounds is for nine months at 6 per cent, then in the first column..."

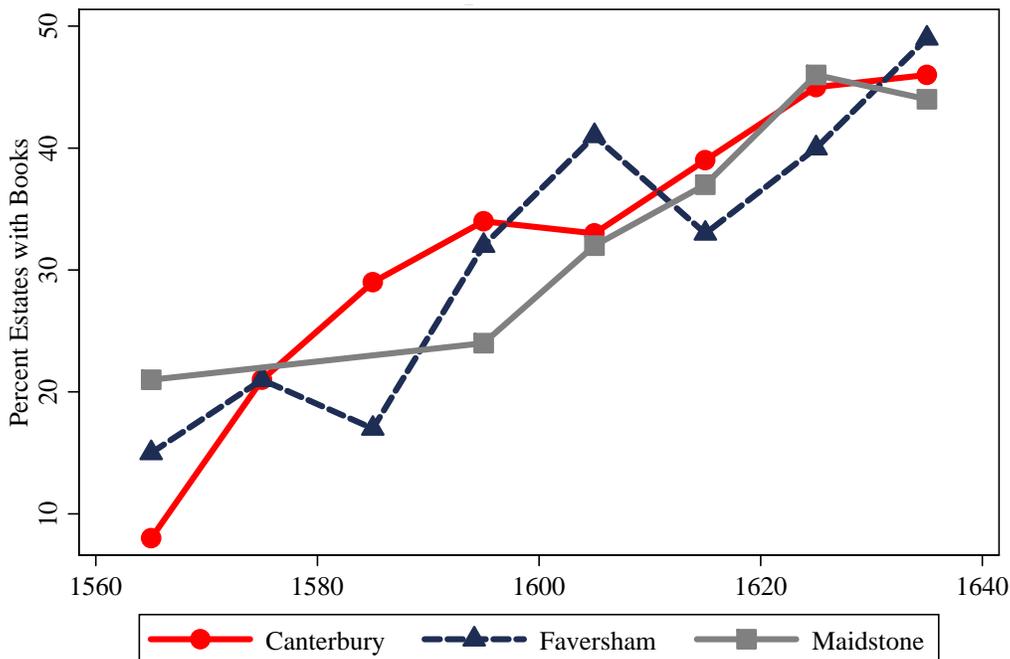
6.2 The Diffusion of and Access to Print Media

Social historians have attempted to gauge the diffusion of and access to print media in a number of ways. They have examined records of book ownership, literacy rates, book sales, and distribution networks. The evidence shows a broad, popular access to books developing over the early modern period. This section discusses the evidence and the debates around its interpretation in the historical literature.

Probate records and wills provide evidence that book ownership was increasing sharply over the early modern era. As an example, probate record data on book ownership are available for three provincial towns in the county of Kent: Canterbury, Maidstone, and Faversham. Figure 8 presents these data 1570-1650. Figure 8 shows that the share of estates with books ranged from 10%-20% around 1570, increased steadily, and reached over 40% by 1640. This evidence illustrates a secular trend found across England. However, probate records are an imperfect source of data. Evidence on probate records are drawn from diocesan and archdiaconal probate collections that typically miss books held by the

wealthiest and the poorest book-owning citizens. The estates of the relatively wealthy were referred by custom and Ecclesiastical law to higher jurisdictions (Cressy 1980, p. 49). Perhaps more importantly, inventories often failed to mention cheaper and more ephemeral books when they were present, in effect undercounting the sorts of books less wealthy individuals were more likely to own (Spufford 1974).

Figure 8: Book Ownership in Three Provincial Towns in Kent

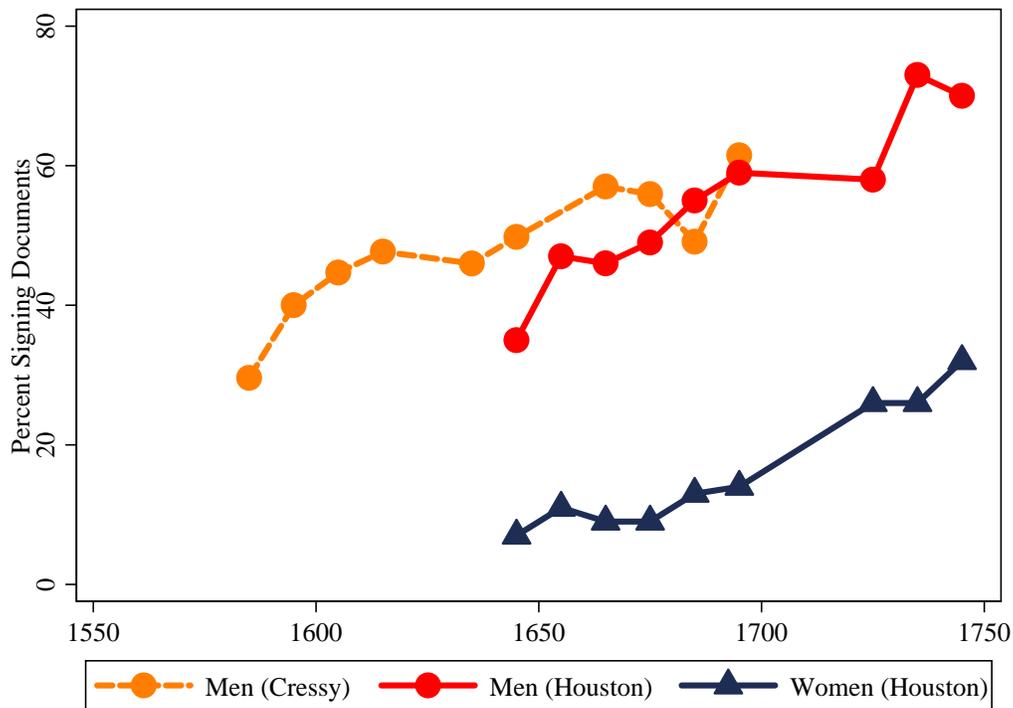


Note: Data from probate records from Clark (1979).

Over the period 1500-1700, literacy rates increased dramatically. However, while rates rose there is debate over the level of literacy rates throughout this period. The debate centers around whether data recording the rate at which individuals signed legal documents can provide a good measure of literacy. Cressy (1980) examines quasi-compulsory loyalty pledges that circulated in the early 1640s. Cressy estimates literacy based on evidence concerning individuals' ability to sign their names. Cressy estimates that literacy rates in the late 1600s were over 40% and 30% for men and women, respectively. Similarly Cressy (1977) and Houston (1982) take signatures on court documents as an index of literacy. Figure 9 documents the data on the rates at which legal documents were signed. However, in early modern England reading was taught before writing and many people who were unable to sign could read. As a result most historians conclude that Cressy's estimates are very significant underestimates of the true ability to read.²⁵

²⁵For discussion and evidence see Schofield (1979), Fox (2000), Watt (1991), and Hackel (2004). These historians argue that 50% of the people Cressy observed to mark rather than sign could in fact read.

Figure 9: Evidence of Literacy – Signatures on Legal Documents

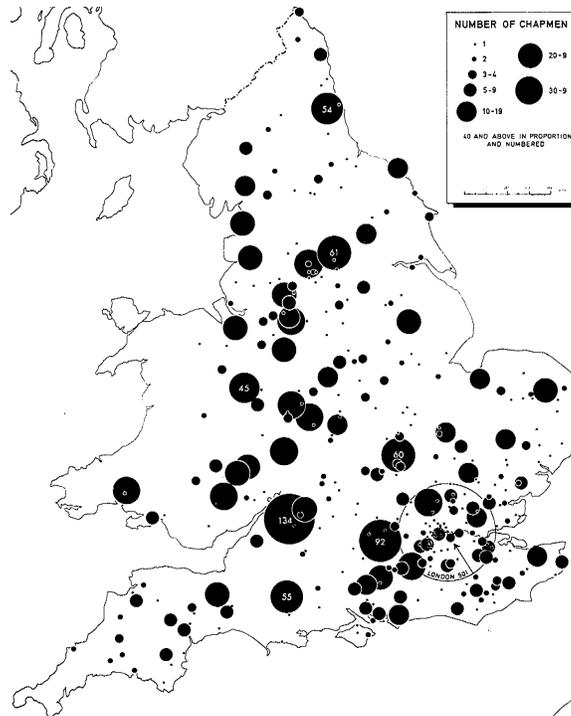


Note: Data Houston (1982) and Cressy (1977).

Data on books sales suggest an increasingly widespread access to print media. The data from the *English Short Title Catalogue* provide evidence that large and increasing numbers of editions were printed in the 1600s. Additional and more precise data on sales is contained in the accounts of the Stationer’s Company. In the 1660s the Stationers’ Company had a legal monopoly on the production of almanacs. Over this we have precise records of annual production and sales. In the 1660s, over 300,000 almanacs were sold annually, enough for one household in three to make a purchase. These almanacs cost approximately 2 pence for 40-50 pages of text. Given observed wages and prices and quantities for almanacs, the implied share of total calibrated book spending devoted to almanacs was approximately 5% in the 1640s.

Sales networks provide further evidence that print media was widely available throughout England. Chapbooks were cheap, popular books typically retailing for 2 pence in the second half of the 1600s. Chapbooks included almanacs, pamphlets, political and religious tracts, nursery rhymes, and poetry. Chapbook sellers were licensed by the government. Government records on licensed chapbooks sellers survive from the mid-1690s. These records provide the name and location over one thousand licensed sellers and their locations across England. Figure 10 maps the locations of the licensed sellers serving communities throughout England.

Figure 10: Licensed Vendors of Popular “Chapbooks” 1694-1695



Note: Chapbooks comprised several genres of popular literature: pamphlets, political and religious tracts, nursery rhymes, poetry, folk tales, almanacs. Figure reproduced from Spufford (1981).

7 Conclusion

The printing press was one of the great revolutions in information technology. The printed book was the signature product of the printing press and one of the most important new goods in human history. This paper documents the welfare effects of the printed book in England 1490-1690 by exploiting data on prices and quantities consumed.

I find that welfare impact of the printed book was equivalent to a 5% increase in income by the 1540s and a 10% increase in income by the 1690s. The same methodology suggests that the welfare impact of the personal computer in the United States has so far been equivalent to a 2-3% increase in income. However, a relatively small fraction of consumption expenditures were devoted to the printed book – indicating that this innovation offered big welfare payoffs relative to expenditure. Broadly, these welfare effects suggest a technologically driven dynamism in living standards that may not be picked up in conventional data on total factor productivity.

References

- [1] Allen, Robert, “Progress and poverty in early modern Europe,” *Economic History Review*, LVI (2003), 403-443.
- [2] ———, *Wages, Prices & Living Standards: The World-Historical Perspective* (2007). Available on-line:
<http://www.economics.ox.ac.uk/Members/robert.allen/WagesPrices.htm>.
- [3] Barbier, Frédéric, *L'Europe De Gutenberg: Le Livre et L'Invention de la Modernité Occidentale* (Paris: Belin, 2006).
- [4] Barnard, John and Maureen Bell, “The English provinces,” in John Barnard and D.F. McKenzie eds., *The Cambridge History of the Book in Britain, Volume IV: 1557-1695* (Cambridge: Cambridge University Press, 2002).
- [5] Baten, Jorg and Jan Luiten van Zanden, “Book production and the onset of modern economic growth,” *Journal of Economic Growth*, 13 (2008), 217-235.
- [6] Bell, H.E., “The Price of Books in Medieval England,” *The Library* (1937).
- [7] Bennett, H.S., *English Books and Their Readers 1475-1557* (Cambridge: Cambridge University Press, 1952).
- [8] Bennett, H.S., *English Books and Their Readers 1558-1603* (Cambridge: Cambridge University Press, 1965).
- [9] Blagden, Cyprian, “The Distribution of Almanacks in the Second Half of the Seventeenth Century,” *Studies in Bibliography*, Vol. 11 (1958), pp. 107-116.
- [10] Blayney, Peter W.M., *The Stationer's company before the Charter, 1403-1557* (Cambridge: The Worshipful Company of Stationers and Newspapermakers, 2003).
- [11] Bolgar, R.R., “Education and Learning,” in R. Wernham, ed., *The New Cambridge Modern History, Vol III: the Counter-Reformation and the Price Revoltion 1559-1610* (Cambridge: Cambridge University Press, 1962).
- [12] Braudel, Fernand, *Civilisation, Économie et Capitalisme*, Vols. I-III (Paris: Armand Colin, 1979).
- [13] British Library, *English Short Title Catalogue* (2011).
- [14] Burigh, Eltjo and Jan Luiten van Zanden, “Charting the ‘Rise of the West’: Manuscripts and Printed Books in Europe, A Long-Term Perspective from the Sixth through Eighteenth Centuries,” *Journal of Economic History*, 69 (2009), 409-445.
- [15] Christianson, C. Paul, *Memorials of the Manuscript Trade in Medieval London* (London: D.S. Brewer, 1987).

- [16] Christianson, C. Paul, "Evidence for the study of London's late medieval manuscript-book trade," in Jeremy Griffiths and Derek Pearsall eds., *Book Production and Publishing in Britain 1375-1475* (Cambridge: Cambridge University Press, 1989).
- [17] Christianson, C. Paul, *A Directory of London Stationers and Book Artisans 1300-1500* (New York: The Bibliographical Society of America, 1990).
- [18] Christianson, C. Paul, "The rise of London's book-trade," in Lotte Hellinga and J.B. Trapp eds., *The Cambridge History of the Book in Britain, Volume III: 1400-1557* (Cambridge: Cambridge University Press, 1999).
- [19] Clair, Colin, *A History of European Printing* (London: Academic, 1976).
- [20] Clair, Colin, *A History of Printing in Britain* (London: Cassell, 1965).
- [21] Clark, Gregory, "The Secret History of the Industrial Revolution," Working Paper, UC Davis (2001).
- [22] ———, "Lifestyles of the Rich and Famous: Living Costs of the Rich versus the Poor in England, 1209-1869," Paper presented in conference, *Towards a global history of prices and wages* (2004). Available on-line at: <http://www.iisg.nl/hpw/papers/clark.pdf>.
- [23] ———, "The Condition of the Working-Class in England, 1209-2004," Working Paper UC Davis (2005).
- [24] ———, "The Condition of the Working-Class in England, 1209-2004," *Journal of Political Economy*, vol. 113, no. 6 (2005b).
- [25] Clark, Peter, "The Ownership of Books in England, 1560-1640: The Example of Some Kentish Townsfolk," in Lawrence Stone ed., *Schooling and Society: Studies in the History of Education* (Baltimore: Johns Hopkins University Press, 1976).
- [26] Cressy, David, *Literacy and the Social Order: Reading and writing in Tudor and Stuart England* (Cambridge: Cambridge University Press, 1980)
- [27] Cressy, David, "Levels of Illiteracy in England, 1530-1730," *The Historical Journal* Vol. 20, No. 1 (1977), pp. 1-23.
- [28] Cuijpers, Peter M.H., *Teksten Als Koopwaar: Vroege drukkers verkennen de markt* (Nieuwkoop: De Graaf, 1998).
- [29] David, P. (1990), "The Computer and the Dynamo: An Historical Perspective on the Modern Productivity Paradox," *American Economic Review, Papers and Proceedings*, Vol. 80, No. 2, pp. 355-361
- [30] David, P. (1997), *Behind the Diffusion Curve*, Boulder; Westview.
- [31] *Early English Books Online*, <http://eebo.chadwyck.com/home>.
- [32] Eisenstein, Elizabeth L., *The Printing Press as an Agent of Change: Communications and Cultural Transformations in Early-Modern Europe* (Cambridge: Cambridge University Press, 1979).

- [33] Febvre, Lucien and Henri-Jean Martin, *L'Apparition du Livre* (Paris: Albin Michel, 1958).
- [34] Fergus, Jan, "Provincial servants' reading in the late eighteenth century," in James Raven, Helen Small, and Naomi Taylor eds., *The practice and representation of reading in England* (Cambridge: Cambridge University Press, 1996).
- [35] ———, "Printing at the dawn of the sixteenth century" in Jean-François Gilmont ed., *The Reformation and the Book* (Aldershot: Ashgate, 1998).
- [36] Ford, Margaret Lane, "Importation of printed books into England and Scotland," in Lotte Hellinga and J.B. Trapp eds., *The Cambridge History of the Book in Britain, Volume III: 1400-1557* (Cambridge: Cambridge University Press, 1999).
- [37] Fox, Adam, *Oral and Literate Culture in England 1500-1700* (Oxford: Clarendon, 2000).
- [38] Glaister, Geoffrey, *Encyclopedia of the Book* 2nd Edition (London: British Library, 1996)
- [39] Gilmore, Myron P., *The World of Humanism, 1453-1517* (New York: Harper, 1952).
- [40] Greenwood, Jeremy and Karen Kopecky, "Measuring the Welfare Gain from Personal Computers: A Macroeconomic Approach," Working Paper (2011). On-line: www.karenkopecky.net
- [41] Goolsbee, Austan Peter J. Klenow, "Valuing Consumer Products by the Time Spent Using Them: An Application to the Internet," *AEA Papers and Proceedings*, Vol 96, No. 2 (2006), pp. 108-113.
- [42] Hay, D. (1962), "Literature: the Printed Book," in G. Elton, ed., *The New Cambridge Modern History, Vol. II: The Reformation 1520-1559*, Cambridge; Cambridge University.
- [43] Hausman, Jerry, "Cellular Telephone, New Products, and the CPI," *Journal of Business & Economic Statistics*, Vol. 17, No. 2 (1999), pp. 188-194.
- [44] Hersch, Jonathan and Hans-Joachim Voth, "Sweet Diversity: Colonial Goods and the Rise of European Living Standards after 1492," (2009) on-line: http://papers.ssrn.com/sol3/cf_dev/AbsByAuth.cfm?per_id=143391
- [45] Hill, Christopher, *The World Turned Upside Down: Radical Ideas During the English Revolution* (Harmondsworth: Penguin Books, 1975).
- [46] Hirsch, Rudolf, *Printing, Selling and Reading 1450-1500* (Wiesbaden: Harrossowitz, 1967).
- [47] Jardine, Lisa, *Worldly Goods: A New History of the Renaissance* (New York: Doubleday, 1996).
- [48] Laqueuer, T. (1976), "The Cultural Origins of Popular Literacy in England 1500-1850," *Oxford Review of Education*, Vol. 2, No. 3, pp. 255-275.

- [49] McKenzie, D.F., “Printing and publishing 1557-1700: constraints on the London book trades,” in John Barnard and D.F. McKenzie eds., *The Cambridge History of the Book in Britain, Volume IV: 1557-1695* (Cambridge: Cambridge University Press, 2002).
- [50] Mendle, Michael, “De Facto Freedom, De Facto Authority: Press and Parliament, 1640-1643,” *The Historical Journal*, Vol. 38, No. 2 (1995), pp. 307-332.
- [51] Mokyr, Joel, “Long-Term Economic Growth and the History of Technology,” in P. Aghion et al. eds., *The Handbook of Economic Growth*, Vol. 1B (Amsterdam: Elsevier, 2005a).
- [52] ———, “The Intellectual Origins of Modern Economic Growth,” *Journal of Economic History*, 65 (2005b), 285-351.
- [53] ———, *The Gifts of Athena: Historical Origins of the Knowledge Economy* (Princeton: Princeton University Press, 2002).
- [54] ———, *Lever of Riches: Technological Creativity and Economic Progress* (Oxford: Oxford University Press, 1990).
- [55] Neddermeyer, Uwe, “Why were there no riots of the scribes?” *Gazette du livre médiéval*, 31 (1997), 1-8.
- [56] Needham, Paul, “The customs rolls as documents for the printed book trade in England,” in Lotte Hellinga and J.B. Trapp eds., *The Cambridge History of the Book in Britain, Volume III: 1400-1557* (Cambridge: Cambridge University Press, 1999).
- [57] Nicholas, David, *Urban Europe, 1100-1700* (London: Palgrave MacMillan, 2003).
- [58] Pollard, Graham, “The Company of Stationers Before 1557,” *The Library*, Vol. XVIII, No. 1 (1937), pp. 1- 38.
- [59] Pollard, Graham, “Notes on the Size of the Sheet,” *The Library*, Vol. XII, No. 1-2 (1941), pp. 106-137.
- [60] Pettegree, Andrew, *The Renaissance Book* (New Haven: Yale University Press, 2010).
- [61] Postan, Michael M., *The Medieval Economy and Society* (Harmondsworth: Pelican, 1979).
- [62] Raven, James, *The Business of Books: Booksellers and the English Book Trade 1450-1850* (New Haven: Yale University Press, 2007).
- [63] Roberts, John M., *A History of Europe* (London: Penguin, 1996).
- [64] Schram, Wilbur Lang, “The Cost of Books in Chaucer’s Time,” *Modern Language Notes*, Vol. 48, No. 3 (1933), pp. 139-145.

- [65] Schofield, R.S., "The Measurement of Literacy in Pre-Industrial England," in Jack Goody ed., *Literacy in Traditional Societies* (Cambridge: Cambridge University Press, 1975).
- [66] Smith, Margaret, "Printed foliation: forerunner to printed page-numbers?" *Gutenberg-Jahrbuch* Vol. 63 (1988), pp. 54-70.
- [67] Spufford, Margaret, *Contrasting communities: English villagers in the sixteenth and seventeenth centuries* (Cambridge: University of Cambridge Press, 1974).
- [68] Spufford, Margaret, *Small Books and Pleasant Histories: Popular Fiction and Its Readership in Seventeenth Century England* (Athens: University of Georgia Press, 1981).
- [69] Sullivan, Richard, "Measurement of English Farming Technological Change, 1523-1900," *Explorations in Economic History*, Vol. 21 (1984), pp. 270-289.
- [70] Zanden, Jan Luiten van, "Common workmen, philosophers and the birth of the European knowledge economy," Paper for Global Economic History Network conference, "Useful Knowledge" (2004). On-line at: www.iisg.nl/research/jvz-knowledge_economy.pdf.
- [71] Zaret, David, *Origins of Democratic Culture: Printing, Petitions, and the Public Sphere in Early-modern England* (Princeton: Princeton University Press, 2000).