Centre for Global Economic History
RECONSTRUCTING THE HISTORY OF GLOBAL INEQUALITY

Universiteit Utrecht

CGEH Working Paper Series

# Human Capital Formation from Occupations: The 'Deskilling Hypothesis' Revisited

Alexandra M. de Pleijt, Utrecht University

Jacob L. Weisdorf, University of Southern Denmark, Utrecht University, CEPR

June 2014

Working paper no. 57

www.cgeh.nl/working-paper-series/

# Human Capital Formation from Occupations: The 'Deskilling Hypothesis' Revisited

Alexandra M. de Pleijt, Utrecht University

Jacob L. Weisdorf, University of Southern Denmark, Utrecht University, CEPR

**Abstract**: We use occupational titles from English parish registers in an attempt to test the deskilling hypothesis, i.e. the notion that England's Industrial Revolution was mainly skill saving. We code the occupational titles of over 30,000 male workers according to the skill-content of their work (using HISCLASS) to track the evolution of working skills in England between 1550 and 1850. Although we observe a minor rise in the share of 'high-quality workmen' deemed necessary by Mokyr and others to facilitate the Industrial Revolution, such as joiners, turners, and wrights, we also find considerable growth in the share of unskilled workers, from 20% in around 1700 to 39% in around 1850, fed mainly by falling shares of semi-skilled blue-collar workers, such as tailors, shoemakers, and weavers. This supports the view that England's Industrial Revolution was not only skill saving on average but also involved a proletarianization of the English workforce.

**Keywords**: Deskilling, HISCLASS, Human Capital, Industrial Revolution, Occupations.

**JEL Codes**: J24, N34, O10.

**Corresponding author**: Alexandra M. de Pleijt, A.M.dePleijt@uu.nl.

**Acknowledgements**: We thank Bas van Bavel, Eltjo Buringh, Dan Curtis, Jessica Dijkman, Oscar Gelderblom, Joost Jonker, Sebastian Keibek, Maarten Prak, Felix Meier zu Selhausen, Leigh Shaw-Taylor, Jan Luiten van Zanden, Nico Voighländer, and Patrick Wallis for helpful comments and suggestions, as well as the seminar and workshop audiences at Utrecht University and the Exeter Landscape of Occupations Workshop. Jacob Weisdorf's research was funded by a Marie Curie Intra-European Fellowship (Grant No 300339).

# I

## Introduction

Economic historians have long debated whether England's Industrial Revolution was largely skill saving or skill demanding. One side holds that the transition from artisan workshops to factory production reduced the need for skilled workers (Goldin and Katz 1998), a view that has received support from three sides: with Humphries (2010, 2013) and Kirby (2005) showing that mass production substantially raised the demand for unskilled workers (including women and children); with Mitch (1999, 2004) and Nicholas and Nicholas (1992) observing a pause during the late 18th century in the rise of male literacy rates; and indirectly with Nuvolari (2002) noting that early industrialization witnessed a considerable number of machine-breaking riots conducted by those who feared that machines would render their skills redundant. The other side stresses the importance of knowledge and working skills to facilitate the innovations and mechanising that made the Industrial Revolution possible in the first place (Mokyr 2009; Mokyr and Voth 2009: Meisenzahl and Mokyr 2012). This view has received support from the work of van der Beek (2012) documenting a rising number of apprentice contracts within 'high-quality' trades, such as joiners, turners, and wrights, in 18th-century England, and from Squicciarini and Voighländer (2014) linking the French Industrial Revolution to a small, highly knowledgeable elite.

Previous work attempting to quantify the evolution of average working skills during England's Industrial Revolution has focused on three key measure of human capital: literacy rates, numeracy rates, and statistics regarding apprenticeships. Though carefully developed and meticulously documented, these measures are arguably rather indirect. The abilities to read, write, and reason with numbers indicate only very basic

competencies. For example, the literacy rate assigns the same skills to a literate farm worker and a literate university professor, with no distinction made between the large variations in ability required to perform these two very different roles. It is also questionable whether or not the rising standards in literacy in the centuries leading up to the Industrial Revolution increased the workers' ability to perform work of economic value, i.e. they could have resulted from the rise and spread of Protestantism rather than from a demand for this ability by employers (Clark 2007). Using statistics regarding apprenticeships is a competent means to study the training of people with lengthy education. But when the apprenticeship era was at its height (around 1700) only four per cent per year of the English population signed a contract and over 50% of those who signed failed to complete it (Wallis 2008). Moreover, since only rather affluent families were able to afford them, apprenticeships tell us very little about the human capital of the (more numerous) lower socio-economic ranks. Last but not least, the fact that any skills obtained were not necessarily used productively (such as a farm worker's ability to read, write, and reason with numbers) makes the potential discrepancy between the *acquisition* of skills and the *application* of skills in productive activities a relevant matter, and one which is difficult to address using the existing measures.

In this paper we aim to quantify both the evolution in average working skills used in productive activities during England's Industrial Revolution and the evolution in the size of the 'upper-tail knowledge elites' (Mokyr 2005). To this end, we explore information derived from a large set of occupational titles recorded in English parish registers between the 16th and 19th centuries, including more than 30,000 male workers holding a total of 284 different occupational titles. We code our occupational titles according to the working skills required for an average performance of the job

using the so-called HISCLASS scheme developed by Van Leeuwen and Maas (2011). Next, we study the evolution across time in the share of unskilled workers among different social groups (blue-collar versus white-collar workers) and within the different sectors of production (primary, secondary, tertiary). We also study the 'density of the upper tail' of professional knowledge by focusing on a set of occupations that Mokyr (2005) deemed necessary to facilitate the Industrial Revolution (joiners, turners, wrights, etc.).

We find that our sampled workforce was remarkably well trained during the 16th century, with only 20% of all sampled workers coded as 'unskilled' according to the HISCLASS scheme. But we also find a dramatic rise in the share of unskilled workers after 1700: by the 19th century the share of unskilled workers had nearly doubled, comprising 39% of our sampled workforce. These numbers chime with those derivable from (sporadic) social tables and census data, which cover much larger shares of the English workforce than our data. Our findings are also robust to a large variety of specifications, including our controls for compositional effects, as well as time- and parish-fixed effects.

By splitting our sampled workforce into blue-collar (manual) and white-collar (non-manual) workers, it becomes clear that the deskilling we observe was chiefly a blue-collar phenomenon. The shares of lower- and medium-skilled blue-collar workers declined substantially from 1700 onwards, while the share of unskilled blue-collar workers grew from 24% to 43%. The skill structures among white-collar workers, however, remain largely constant over the course of the Industrial Revolution. We also find that some of the deskilling in our sampled population stems from upward social

mobility across the life cycle: in the 19th century 41% of the sampled workers were unskilled at the time of their marriage, but only 33% were unskilled at the time of death. Our in-depth analysis of the professions believed to be vital to England's Industrial Revolution shows an increase in what Mokyr (2009) calls 'high-quality workmen'. The share of professions including joiners, turners, and wrights displayed modest growth, from 3.9% to 4.7% between the 16th and the 19th centuries. But this was clearly not enough to counterbalance the vast decline in the shares of lower-skilled and (particularly) medium-skilled craftsmen (weavers, tanners, glovers, tailors, shoemakers, coopers, smiths, etc.) observed after 1700. Not only was England's Industrial Revolution chiefly skill saving, but we also find evidence of a proletarianization in agriculture between the late 16th century and the early 18th century, suggesting that technical change during the early modern period led to considerable downward social mobility for the English population.

## II

## Data and Analysis

The key source of the data used in our analysis comes from the Cambridge Group's *Family Reconstitution Data*. This dataset was built around information derived from ecclesiastical events recorded in 26 English parishes (Wrigley et al 1997).[1] The full data set covers more than three centuries of English demographic history, from the first emergence of parish registration, in 1541, until population census became common, in 1871. The parishes represent a variety of locations in England, ranging from large market towns to remote rural villages, including proto-industrial, retail-handicraft, and agricultural communities (Schofield 1970).

[1] These parishes are: Alcester, Aldenham, Ash, Austrey, Banbury, Birstall, Bottesford, Bridford, Colyton, Dawlish, Earsdon, Grainsbro, Gedling, Great Oakley, Hartland, Ipplepen, Lowestoft, March, Methley, Morchard Bishop, Odiham, Reigate, Shepshed, Southill, Terling, and Willingham.

The sampled occupational titles were recorded on the occasion of three ecclesiastical events: marriage, burial, or baptism (or burial) of offspring. Some individuals were recorded several times, others only once. Multiple entries, notably in the context of baptising offspring, introduce a potential bias in the data, since individuals who baptise many children enter the data more often. Previous research has shown that the rich were not only more skilled than the poor but they also had more children (Clark and Hamilton 2006; Boberg-Fazlic et al. 2011). That raises the risk that the rich will be overrepresented in the sample, and hence that we thus overestimate the skill acquisitions of the sampled population. We eliminate the bias by including each individual only once, at the time of their earliest recorded occupation. Among our sampled males, 20% had their first occupation recorded at the time of their marriage; 51% when baptizing a child (43% when baptizing their first child, i.e. within one to two years off their marriage); and 29% at the time of their burial. In a later robustness analysis we control for potential composition effects arising from the fact that some were recorded early in life and others later.

Four occupational titles – 'Gentleman', 'Esquire', 'Pauper', and 'Widower' – were excluded from the original dataset. These titles, making up 4% of the sampled population, do not refer to an actual profession, and hence cannot be coded using the HISCLASS scheme (see description below). Our findings are robust to the inclusion of three of those titles on the assumption that paupers are unskilled and gentry and esquires are (highly) skilled.

Following Wrigley et al. (1997, p. 43ff), one of the 26 sampled parishes, Birstall, was removed from the sample in order to make the occupational structure of reconstitution data match that of the rest of England. Birstall had on average 100

occupations per fifty years, except for the period of 1750-99 when it had a staggering 2,200 observations making up more than one-fourth of all the sampled occupations (of all the parishes) in that period. The inclusion of Birstall would thus heavily distort the skill-structure in 1750-99. Including Birstall without the 1750-99 period does not alter our conclusions below.

Our goal is to infer information about the working skills of the sampled workforce from their occupational titles and to study the evolution of working skills across time, notably during the classic years of the Industrial Revolution (1750-1850) but also (because the data allows this) going two centuries back in time prior to the Industrial Revolution (to 1550). To this end, we code the sampled occupational titles using the so-called HISCO-/HISCLASS schemes. The HISCO (Historical International Standard Classification of Occupations), developed by Van Leeuwen et al (2002, 2004), comprises 1,675 distinct job categories. In a follow-up book, titled *HISCLASS: A historical international social class scheme*, Van Leeuwen and Maas (2011) applied the principles of the Dictionary of Occupational Titles (DOT) to extract information about the working skills of incumbents of historical occupations coded in the HISCO system. The DOT was developed in the 1930s by the US Employment Service in response to a rising demand to standardise occupational information to assist job-placement activities (US Department of Labor, 1939). In order to efficiently match jobs and workers, the public employment service system required that a uniform occupational language be used in all of its local job service offices. Through an extensive occupational research programme, occupational analysts collected and provided data to job-market interviewers, to help them match the specifications given in job openings to the qualifications of job applicants. Based on the data collected by occupational analysts, the first edition of the

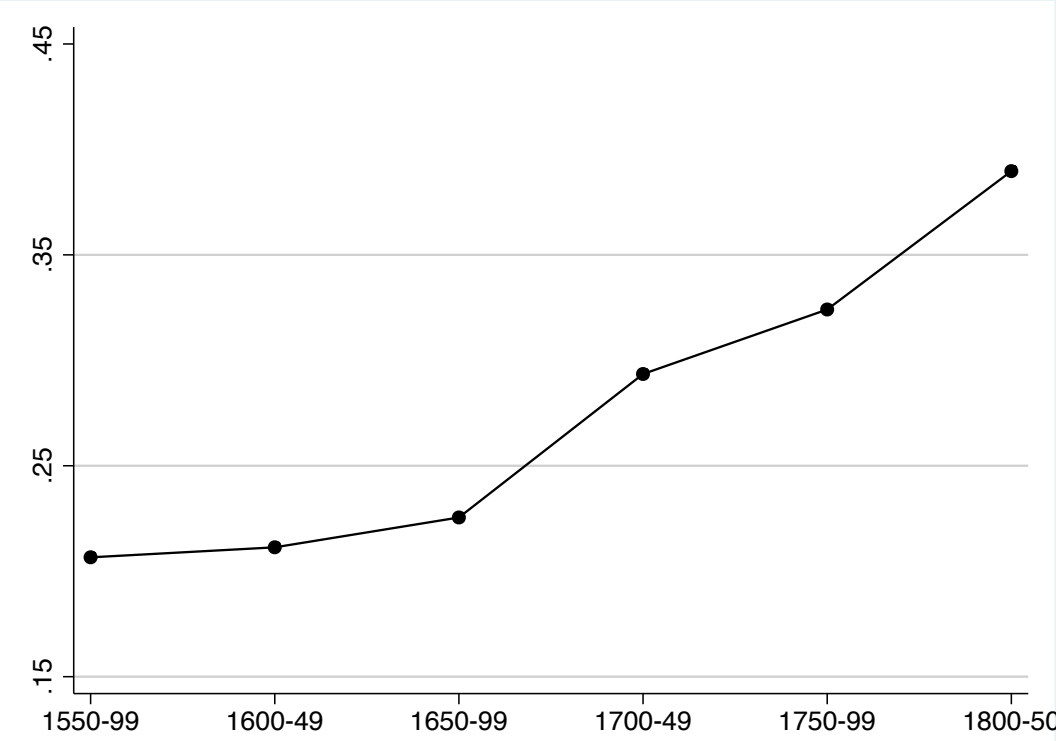
DOT was published in 1939, containing some 17,500 job definitions, presented alphabetically, by title, with a coding arrangement for occupational classification.

The transformation of occupational titles into working skills in the HISCLASS scheme builds on two main scores used in the DOT: the *General Educational Development* score and the *Specific Vocational Training* score. The score concerning general educational development captures three key features regarding the intellectual competencies necessary to fulfil the tasks and duties of an occupation: the incumbent's reasoning development; his or her ability to follow instructions; and the acquisition of language and mathematical skills needed to conduct the work. The score concerning specific vocational training captures the time investments needed in three main areas: the time required by the worker to learn the techniques used on the job; the time needed to acquire the relevant information to conduct the work; and the time necessary to develop the competencies required for an average performance in a job-specific working situation.

Building on the expertise provided by Bouchard (1996) and a team of labour historians, Van Leeuwen and Maas used the two DOT scores to code the occupational titles categorised in HISCO according to the skill-content of the work, as part of a procedure to create the HISCLASS scheme. In the HISCLASS scheme, occupational titles were grouped in four categories: *unskilled*, *lower-skilled*, *medium-skilled*, or *higher-skilled*. Our sampled workforce contained 284 different occupational titles identified by the HISCO and hence 'codeable' in the HISCLASS scheme. Table A1 in the Appendix lists the most common occupational titles, and how they were coded in the HISCLASS scheme.

**Figure 1**

The Share of Unskilled Male Workers, 1550-1850

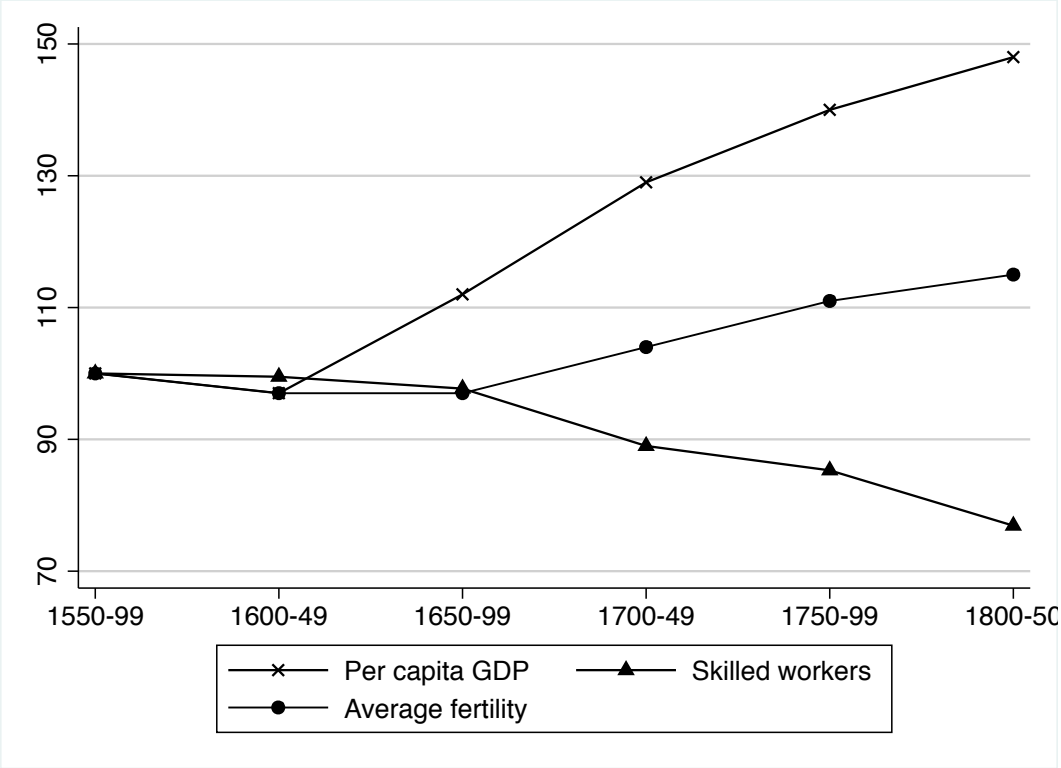



*Note*: Unskilled workers are workers whose occupational title is labelled 'unskilled' in the HISCLASS scheme (see van Leeuwen and Maas 2011). *Source*: CAMPOP data (see text).

We split our sampled observations into fifty-year intervals covering the period from 1550 to 1850. Figure 1 shows the share of workers in the sampled workforce whose professions were deemed 'unskilled' in the HISCLASS scheme. Table A2 in the Appendix reports the exact shares. Figure 1 speaks a very clear language: up until 1700, the sampled workforce was rather well educated, with only one in five workers coded as unskilled. But between 1700 and 1850 a profound process of deskilling took place, with the share of unskilled workers rising to reach two in five workers in the first half of the nineteenth century.

**Figure 2**

The Share of Skilled Workers, GDP per Capita, and Marital Fertility, 1550-1850




*Note*: Index: 1550-99 = 100. *Sources*: GDP per capita: Broadberry et al (2012); the share of skilled workers and marital fertility: CAMPOP data (see text). Skilled workers are workers whose occupational title is coded as 'low-skilled', 'medium-skilled' or 'high-skilled' in the HISCLASS scheme (see van Leeuwen and Maas 2011).

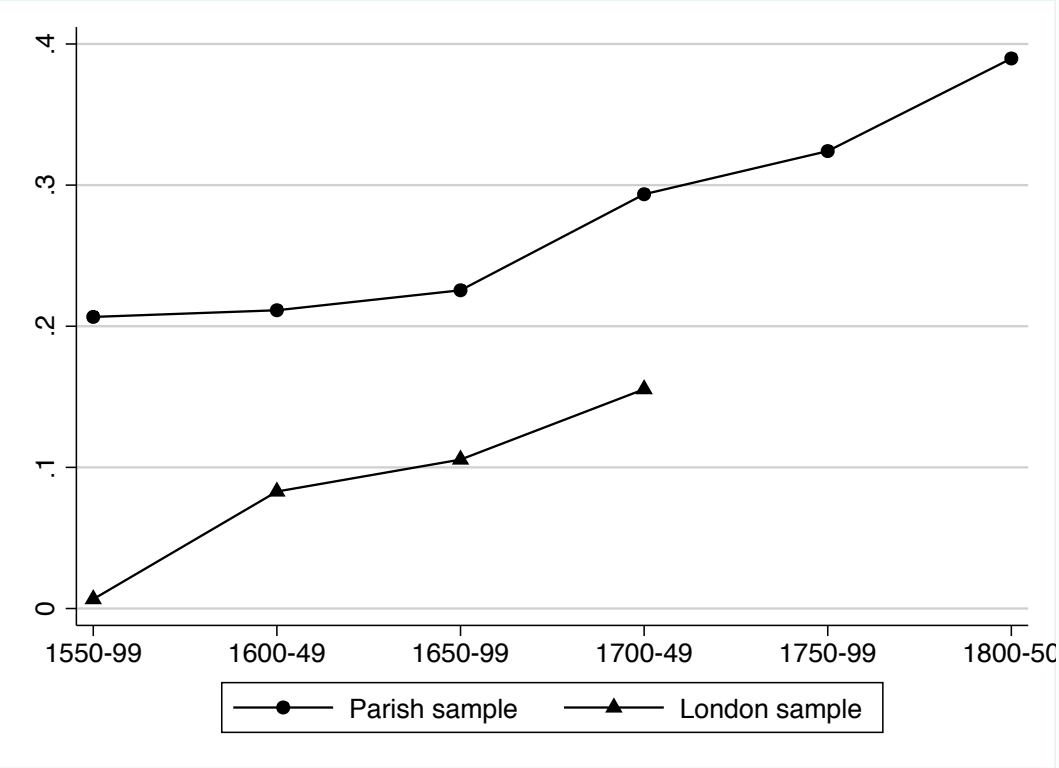
It is interesting to note that the deskilling episode shown in Figure 1 coincides with a period of economic growth as well as population growth. Figure 2 captures this by plotting the shares of skilled workers against the evolution in GDP per capita and marital fertility (all indexed with 1550-50=100). Between 1650 and 1850, GDP per capita rose by 30% and marital fertility by 15% (see Table A3 in the Appendix). At the same time, the share of skilled workers declined by about 23%. In light of these developments, and the fact that economic growth is commonly viewed as being driven by human capital growth (Galor 2005), there is good reason to believe the deskilling observed in Figure 1 is based either on a misreading of the data, or that the data are not

representative of the entire country. The reminder of this section is thus devoted to studying the representation of our data, as well as its robustness with regards to the deskilling result.

An obvious explanation is that skilled workers left the reconstituted province parishes to pursue jobs in urban or industrial centres. Although the reconstituted parishes include everything from large market towns to rural villages, no large urban centres appear in the sample. Work by Newton (2007) and Newton and Baker (2007) allow us to investigate the evolution of working skills among male workers captured in seven parishes in London (five from Cheapside, two from Clerkenwell). Unfortunately, the London data only runs up until 1750. Figure 3 shows the share of unskilled workers in London against that in the provinces (i.e. the reconstituted parishes). It inform us that (as expected) the sampled Londoners were even more highly trained than their provincial counterparts before 1600, with barely any unskilled workers. But the London sample also shows patterns of deskilling. Although this starts earlier than in the provinces, the share of unskilled workers in London grew remarkably over the period of observation: from 8% in 1600-49 to 16% in 1700-49 (Tables A4 in the Appendix). Hence, no immediate support is provided to the possibility of a 'brain drain' from the provinces to the city.

**Figure 3**

The Share of Unskilled Workers in London and the Provinces, 1550-1850




*Note*: Unskilled workers are workers whose occupational title is labelled 'unskilled' in the HISCLASS scheme (see van Leeuwen and Maas 2011). *Sources*: Province data (Wrigley et al 1997). London data: Newton (2007) and Newton and Baker (2007).

If skilled workers left the province, but not for London, did they then go to England's industrial centres? Lancashire and Cheshire are known as the birthplaces of the Industrial Revolution, but are not represented by the reconstituted parishes. The Cambridge Group's occupational data for Lancashire and Cheshire covering two periods, c. 1725 and c. 1812, can help shed light on this.[2] Tables 1 show that Cheshire was subject to considerable deskilling: its share of unskilled workers increased from 17% to 34% between 1725 and 1812, fed by declining shares of lower-, medium-, and highly-skilled workers. In Lancashire, despite considerable growth in the size of the work force, the skill shares were largely constant. As expected, a great deal of the lower-skilled

[2] These data were kindly made available to us by the Cambridge Group, courtesy of Leigh Shaw-Taylor.

workers in Lancashire consists of weavers and spinners (23% in 1725 rising to 34% in 1812). There was a modest drop in the share of unskilled workers, from 11% down to 10%, but an even larger growth in the share of lower-skilled workers. The share of medium-skilled workers declined from 40% to 38%, and the share of highly-skilled workers remained constant. Again, no immediate support is provided to the idea that skilled workers moved from the reconstituted parishes (or elsewhere in England) to the centres of the Industrial Revolution.

**Table 1**

The Share of Workers by Working Skills, Lancashire and Cheshire, c. 1725 and 1812

| | Unskilled | Low-skilled | Medium-skilled | High-skilled | N |
|---|---|---|---|---|---|
| | | | | | |
| Lancashire | | | | | |
| | | | | | |
| c. 1725 | 0.11 | 0.48 | 0.40 | 0.01 | 15,486 |
| c. 1812 | 0.10 | 0.51 | 0.38 | 0.01 | 79,233 |
| | | | | | |
| Cheshire | | | | | |
| | | | | | |
| c. 1725 | 0.17 | 0.30 | 0.51 | 0.02 | 7,691 |
| c. 1812 | 0.34 | 0.19 | 0.45 | 0.01 | 15,254 |

*Source*: CAMPOP data (see text).

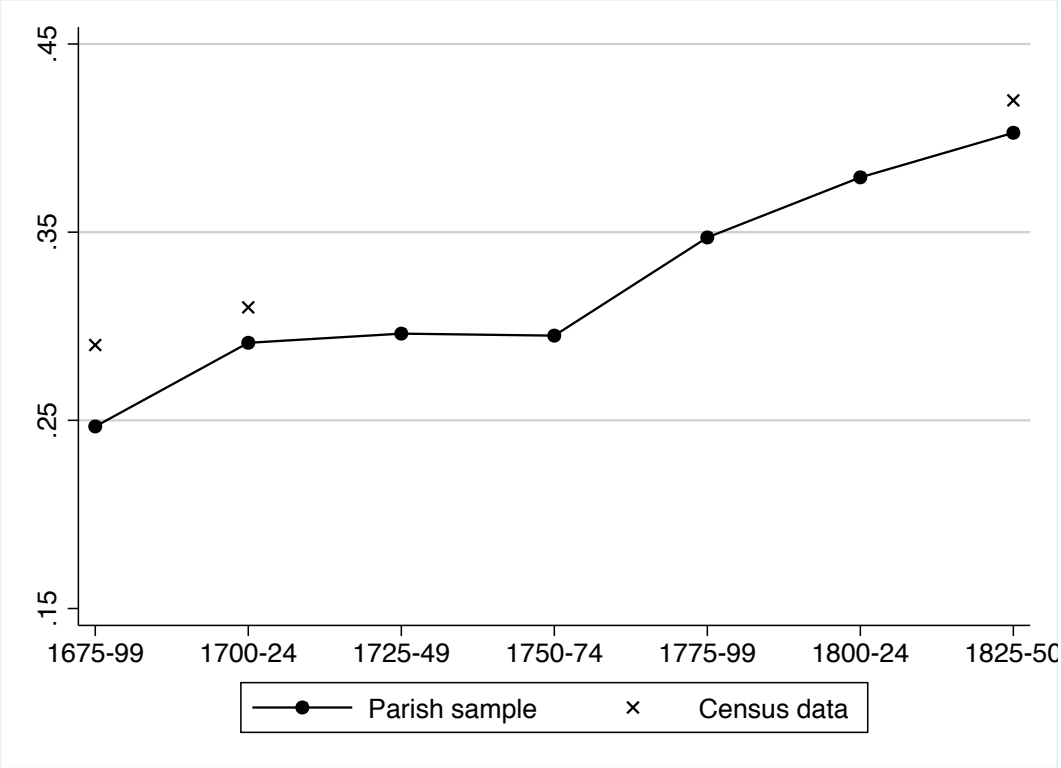
A more general assessment of the representation of the reconstituted provincial parishes can be made by comparing our sampled workforce with England more broadly. To this end, we undertake three spot checks using occupational information from pre-existing census data and social tables. The English social table of 1688, revised and reported in Lindert and Williamson (1982), can be used to calculate the share of

unskilled workers for that year. This social table includes some 1.39 million male workers, of which 29% are classified as 'unskilled' in the HISCLASS scheme. Furthermore, the account of Shaw-Taylor et al (2010) of adult male employment in England and Wales c. 1710 leaves us with 1.48 million workers (after removing 'gentry', 'paupers' and those of 'no occupation'). Among these, 31% were coded as 'unskilled' workers in the HISCLASS scheme. Finally, Booth's grouping of the occupational titles included in the 1841 census of the English population provides a share of unskilled workers equal to 42% (Booth 1886). Booth's census data is particularly interesting since it covers the entire English male workforce at the time: 6.63 million men.

Figure 4 plots the three independent shares of unskilled workers against our sampled workforce (see the exact numbers in Table A5 in the Appendix). Not only do the independent data compare rather well to ours in terms of shares of unskilled workers; they also follow the same trend, displaying the same episode of deskilling that is captured in Figure 1. Interestingly, our sampled workforce slightly underestimates the shares of unskilled workers in the general population.

**Figure 4**

Comparison between the Provinces and Social Tables and Census Data, 1675-1850

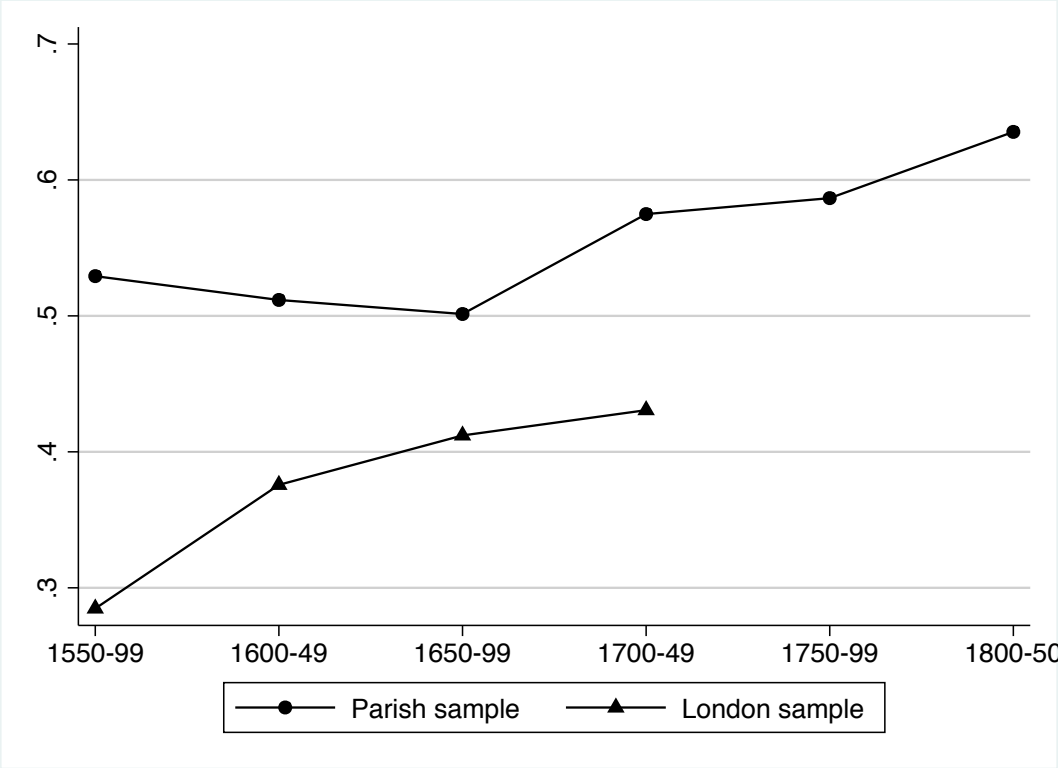



*Sources*: CAMPOP data (see text); social tables: Lindert and Williamson (1982); church book data: Shaw-Taylor et al (2010); census data Booth (1886).

It is no secret that much of the deskilling observed in our data comes from a growing number of men recorded as 'Labourers' in the registers. Some would argue that even ordinary labourers were able to accumulate a fair amount of working skills across their life-cycle, and hence that they should eventually be coded as 'lower-skilled' workers rather than 'unskilled'. A simple way in which to deal with this issue is by 'upgrading' all labourers to lower-skilled workers. Figure 5 shows the result of collapsing lower- and unskilled workers into one group in London and in the provinces, respectively (Tables A2 and A4 in the Appendix). The graph largely replicates the patterns from Figure 3, with deskilling in London up until 1750 (from 29% in 1550 to 43%) and in the provinces after 1700 (from 50% to 63% by 1850).

**Figure 5**

The Share of Lower- and Unskilled Workers in London and the Provinces, 1550-1850



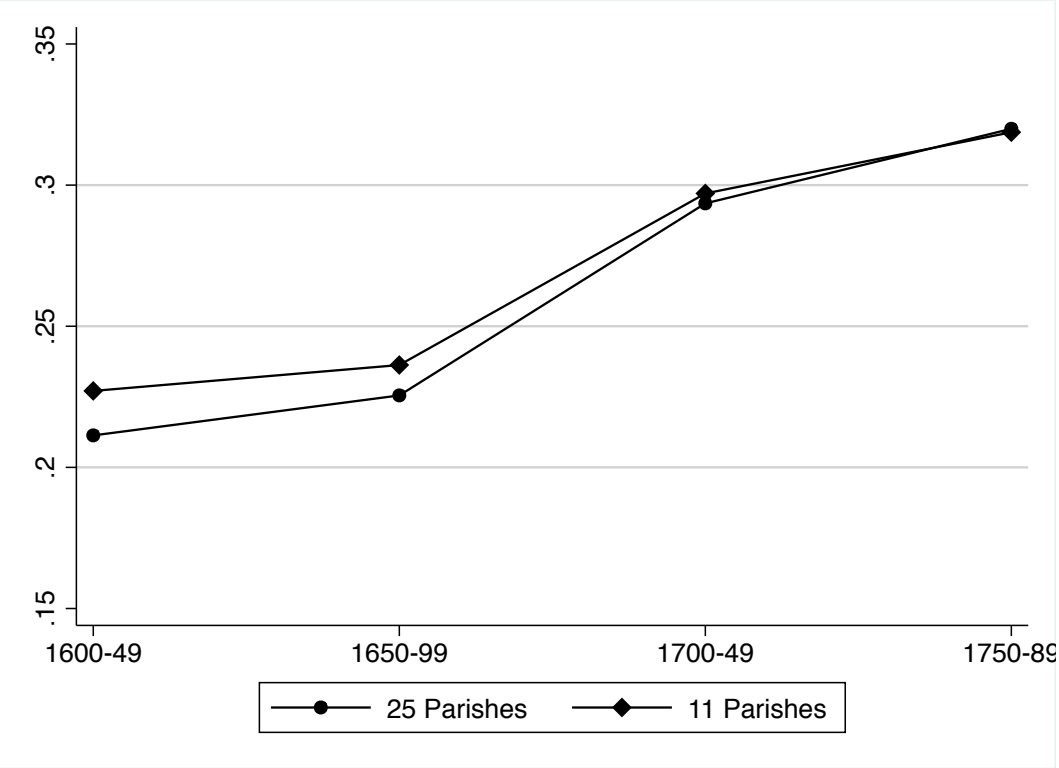

*Sources*: CAMPOP data (see text); London sample: Newton (2007) and Newton and Baker (2007).

Another well-known issue with our data is that the parishes included change across the period of observation (Wrigley et al 1997). This could give rise to compositional effects. For example, deskilling could be caused by moving from parishes with relatively few unskilled workers to parishes with relatively many. Fortunately, we are able to control for such compositional effects by comparing those 11 parishes[3] that cover most of our period (i.e. 1600-1789) with those 25 parishes that we have included thus far. Figure 6 plots the results showing that the trends in the two samples are remarkably similar (see Table A6 in the Appendix for exact numbers). This conclusion is validated in our later regression analysis, which controls for parish fixed effects.

[3] These include Aldenham, Banbury, Bottesford, Colyton, Grainsbro, Gedling, Methley, Odiham, Shepshed, Southill and Terling.

**Figure 6**

Controlling for Compositional Effects, 1600 -1789




*Source*: CAMPOP data (see text).

Another potential problem concerning compositional effects arises from the fact that our individuals are observed at different points across their life-cycle: some at their marriage, some at their burial, some in-between (when baptising a child). This poses a problem if individual skills change across the life-cycle. For example, an individual may rise up the occupational ladder due to life-long learning-by-doing, or step down the occupational ladder because of loss of physical or mental abilities due to injury or old age. If skills increase across the life-cycle (as our analysis below confirms), and if we mostly observe occupations at the time of the burial to begin with and at the time of the marriage later on, then this could potentially account for the deskilling we observe.

**Figure 7**

The Share of Unskilled Workers: Marriage versus Burial Occupations, 1550-1850


*Source*: CAMPOP data (see text).

There are different ways in which to control for such compositional effects. One way is by grouping and studying occupations recorded at the time of the marriage and burial separately against the mixed sample. Figure 7 illustrates this, showing some remarkable patterns. Up until 1700, it makes no difference at what point during the life-cycle our sampled individuals are captured: all three graphs overlap (Table A7 in the Appendix). After 1700, it is clear that deskilling is more dramatic among the marriage cohorts than among the burial cohorts, suggesting that upward social mobility is taking place across the life-cycle for the population as a whole.[4] For example, in the period

[4] Note that we still observe each individual only once, meaning that our burial cohorts are not identical to the earlier marriage cohorts.

1800-50, 41% of the sampled workforce was unskilled at the time of their marriage, but only 33% were unskilled at the time of their death.

The best way in which to deal specifically with time as well as parish fixed effects is, of course, to run a regression that controls for such effects. That approach also allows us to use our statistics at the individual level rather than the aggregated level (as was used in the graphs above). Table 2 reports the results of regressing the individual skill status of our sampled men (i.e. whether they are deemed skilled or unskilled in HISCLASS) on a number of explanatory variables that include a mix of individual and macro information. Compared to males recorded prior to 1600 (the time reference category), Table 2 shows that the probability of being recorded as unskilled increases over time, and the more so the further into the Industrial Revolution one moves. The Table also shows that literacy reduces the probability of being recorded as unskilled, and that males who were born in the same parish were later recorded with an occupation that was more likely to be skilled. The latter result suggests that migrants were on average less skilled than non-migrants.

**Table 2**

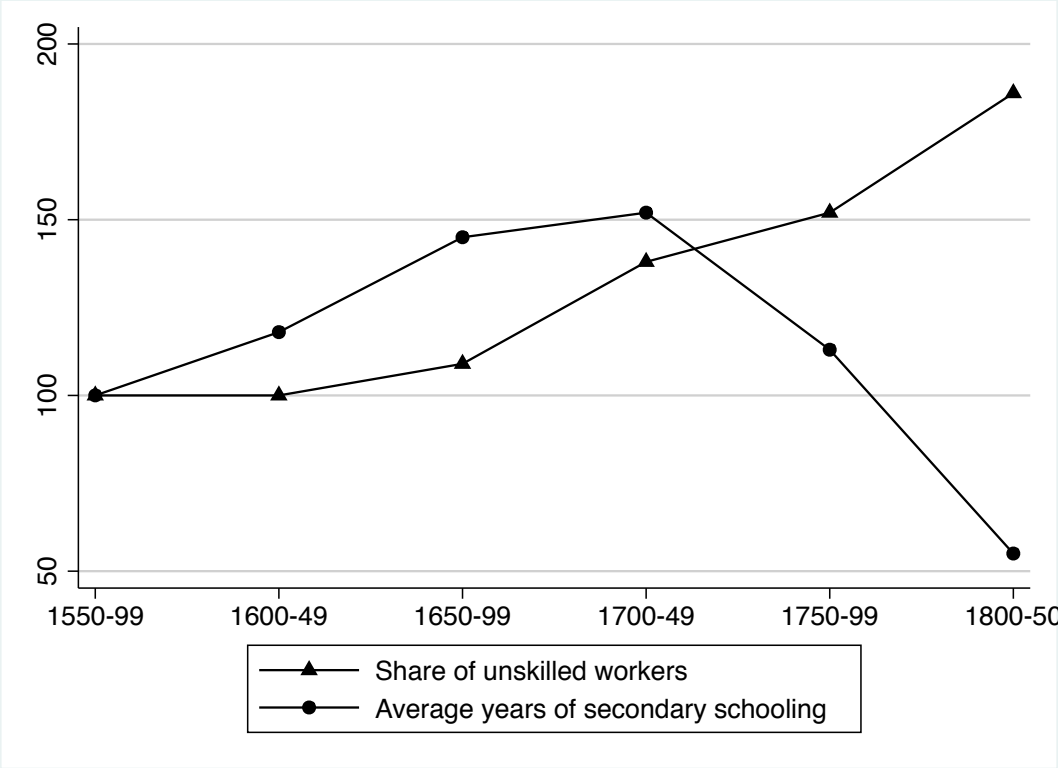
Probit Model: Dependent Variable is Unskilled Occupation

| | (1) | (2) |
|---|---|---|
| Sub-period: 1600-49 | 0.112** | 0.0925** |
| | (2.42) | (2.04) |
| Sub-period: 1650-99 | 0.110** | 0.120*** |
| | (2.43) | (2.70) |
| Sub-period: 1700-49 | 0.376*** | 0.392*** |
| | (8.72) | (9.16) |
| Sub-period: 1750-99 | 0.483*** | 0.497*** |
| | (11.39) | (11.81) |
| Sub-period: 1800-50 | 0.674*** | 0.677*** |
| | (16.19) | (16.51) |
| Occupation recorded at burial | -0.105*** | -0.0831*** |
| | (-4.28) | (-3.41) |
| Born within parish (non-migrant) | -0.0727*** | -0.0775*** |
| | (-4.41) | (-4.76) |
| Individual literate | -1.018*** | -0.993*** |
| | (-31.49) | (-30.77) |
| Industrial parish | -0.885*** | |
| | (-20.62) | |
| Retail or handicrafts parish | -0.296*** | |
| | (-11.37) | |
| Parish of mixed activities | -0.200 | |
| | (-7.71) | |
| Parish located in North England | | -0.0319* |
| | | (-1.79) |
| Constant | -0.103** | -0.368*** |
| | (-2.01) | (-7.86) |
| Number of observations | 28,147 | 28,147 |

*Notes:* The reference category for sub-periods is 1550-99. The reference category for the main economic activity of parish is 'agriculture' (see text). The *t*-values are reported in the parentheses. Asterisks *, **, *** denote significance at the 10%, 5%, and 1% level. *Sources*: CAMPOP data (see text).

**Figure 8**

The Shares of Skilled Workers and Secondary Schooling, 1550-1850




*Note*: Index: 1550-99 = 100. *Sources*: Secondary Schooling: de Pleijt (2014); the share of unskilled workers: CAMPOP data (see text).

Consistent with Figure 7 and confirming the presence of upward social mobility across the life cycle, the regression results show that males recorded at the time of their burial are more likely to be skilled than those recorded earlier in life. Turning to the parish fixed effects, the regression shows that males observed in parishes that Schofield (1970) categorised as 'industrial', 'retail and handicrafts,' or 'mixed' (Column 1) are more likely to be skilled compared to those coming from 'agricultural' parishes (the parish reference category). If we divide the sampled parishes by location (Column 2) rather than by their main economic activity, then it becomes clear that males observed in parishes situated in the north of England (Alcester, Austrey, Banbury, Bottesford, Earsdon, Gainsbro, Gedling, Great Oakley, Lowestoft, March, Methley, Shepshed, Southill,

Terling, and Willingham) are more often skilled compared to individuals recorded in the south. This is consistent with the idea that the south was more orientated towards agricultural activities and hence less skill demanding.

Before we proceed to explore whether deskilling was a general phenomenon or something that adhered to certain sectors or groups of workers, it would be interesting to establish whether deskilling was a pure demand-side effect, i.e. whether there was a discrepancy between the workers' *acquisition* of skills and the employer's *application* of the workers' skills. Although this is hard to document, Figure 8 plots the evolution in the share of unskilled workers against the evolution in secondary school enrolment rates reported by de Pleijt (2014).[5] Both series are indexed with 1550-99 = 100 (see also Table A8 in the Appendix). The graph shows that up until the mid-18th century secondary school enrolment increased even though workers used fewer skills in production on average. After 1750, however, secondary school enrolment declined in tandem with the fall in the average use of working skills, confirming the idea that workers' acquisition of skills went hand-in-hand with the employers' use of skills in production.

## III

## A Closer Look

The increase in the share of unskilled workers found in the previous section does not tell us whether deskilling was a general phenomenon, or whether it was confined to certain groups of workers or sectors of production. To shed some light on these matters, we decompose the sampled population into blue-collar and white-collar workers to study

[5] Secondary school enrollment builds on the number of secondary schools per person.

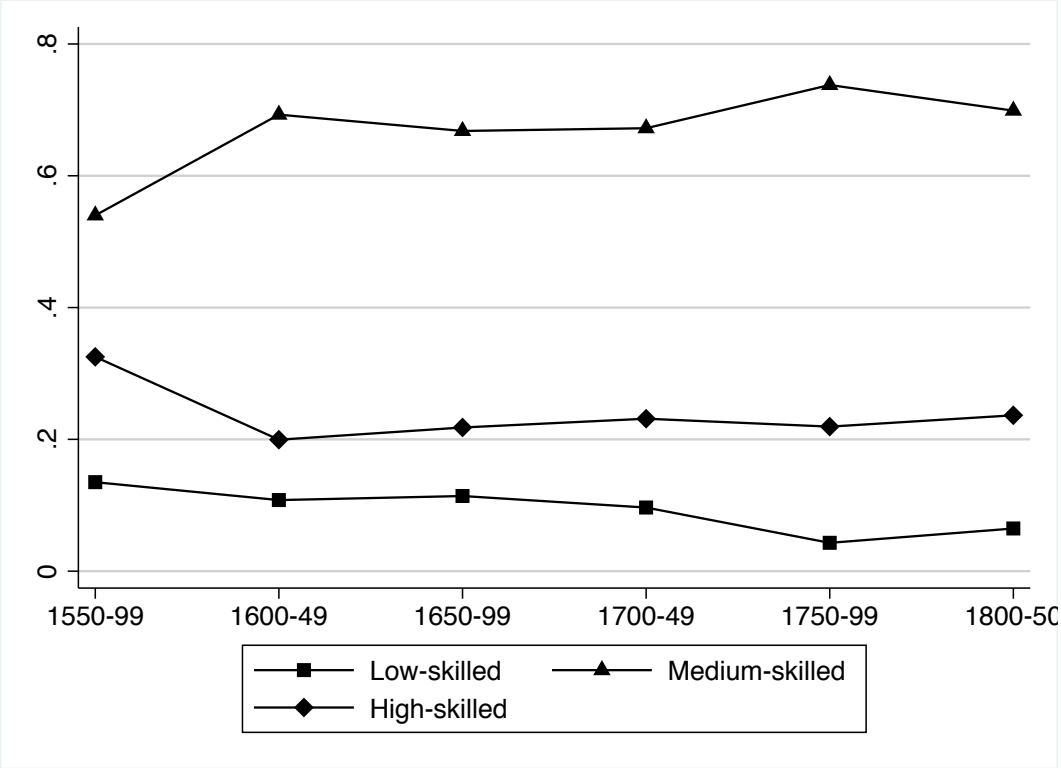
the evolution of skills within each group. We also divide our sampled population by their sector of production (primary, secondary, and tertiary) using the PST system, developed by Wrigley (2010), to see if deskilling was a purely manufacturing phenomenon or whether it appeared in other sectors of production as well such as agriculture.

Conveniently, the HISCLASS scheme makes it possible to split our sampled occupations into blue-collar (manual) workers and white-collar (non-manual) workers (van Leeuwen and Maas 2011). White-collar work includes semi-professional office, administrative, and sales-coordination jobs, counting job titles such as 'Clerk', 'Salesman', and 'Manager'. In contrast, blue-collar work refers to jobs requiring manual labour and include professions in fields such construction, mining, and farming. Blue-collar workers make up 87% of the sampled population in 1550-99, growing to 91% in 1800-50.

White-collar workers have no category for unskilled labour in the HISCLASS, so Figure 9 tracks the evolution of the shares of lower-, medium-, and highly-skilled white-collar workers. The share of lower-skilled white-collar workers remains largely constant over time, with one in five workers falling into this category. Among the white-collar workers there were 54-70% that were deemed medium-skilled and 24-33% that were deemed highly-skilled. The early 17th century saw a rise in the share of medium-skilled white-collar workers and a comparable fall in the share of lower-skilled white-collar workers (Table A9 in the Appendix). After 1700, the share of medium-skilled white-collar workers rose again, this time fed primarily by a fall in the share of highly-skilled white-collar workers, implying a weak deskilling effect among the white-collar sample during the Industrial Revolution.

**Figure 9**

The Share of Skills Among White-Collar (Non-Manual) Workers, 1550-1850

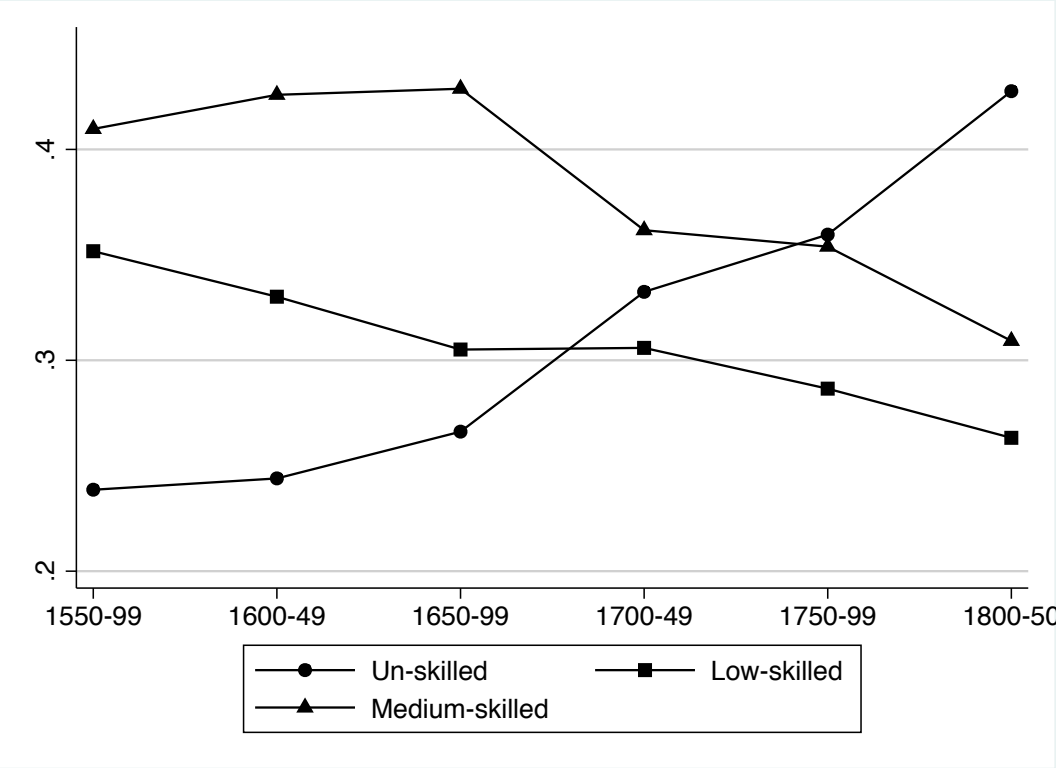



*Source*: CAMPOP data (see text).

There were far more dramatic changes occurring among blue-collar workers (Figure 10). This group of workers has no category for highly-skilled workers. To begin with, the blue-collar workforce is dominated by medium-skilled workers (42%) and lower-skilled workers (36%), with less then one out of four workers coded as unskilled. Up to 1700, the shares of medium- and unskilled blue-collar workers rose modestly, fed by a falling share of lower-skilled blue-collar workers (see also Table A10 in the Appendix). After 1700, the share of unskilled blue-collar workers rose substantially, from 26% in around 1700 to 42% in around 1850. This came with a modest fall in the share of lower-skilled blue-collar workers (from 31% to 26%) and a considerable drop in the share of medium-skilled blue-collar workers (from 43% to 31%). From this, it is clear that the deskilling was mainly a blue-collar phenomenon.

**Figure 10**

The Evolution of Skills Among Manual workers, 1550-1850




*Source*: CAMPOP data (see text).

Was the deskilling mainly a secondary-sector phenomenon reflecting the transition from artisan workshops to factory production? Or did it occur in the primary and tertiary sectors as well? Unfortunately, a decomposition of our occupations into sectors of production is not a straightforward task. While the PST scheme (Wrigley 2010) offers a way to code our occupations in this regard, previous work has struggled with how to distribute the workers recorded as 'Labourer' across the different sectors of production (e.g. Broadberry et al 2012; Shaw-Taylor 2012).

Below, we rely on the assumptions previously made regarding three distinct periods: 1550-99, 1700-24, and 1825-50. For sub-period 1550-99, we follow the assumption made by Broadberry et al (2012), which allocates 62.8% of all labourers to

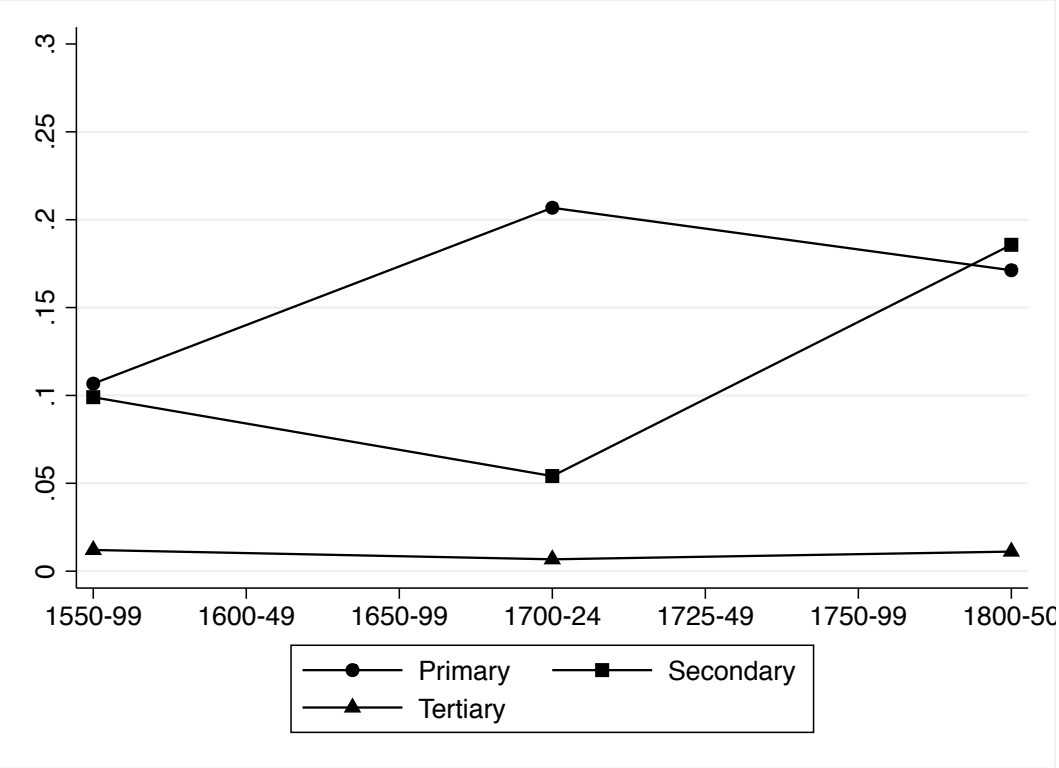
primary activities and the rest to secondary activities. Underlying this assumption is the allocation of labourers by sector offered in the Munster Rolls of 1522. For the period 1700-24, we follow Shaw-Taylor (2012) who assumes that 80% of all labourers belonged in primary activities and the rest in secondary activities. This is based on Shaw-Taylor's study of the occupational structures from church book registers in England and Wales around 1710 mentioned earlier (see Shaw-Taylor et al 2010). Finally, for the period 1825-50, we rely on work by Schofield (1973), which sub-divides our 25 parishes into four groups ('agricultural', 'industrial', 'retail-handicraft', and 'mixed') depending on their occupational structure in the 1831 population census (also used in our regression analysis above). Schofield's 'agricultural' parishes (eight in total)[6] had at least 60% of male workers over the age of 20 employed in the primary sector. Using this approach to calculate the share of labourers in primary activities 47.2% of our workers went into primary activities and the rest to secondary activities.

Figure 11 shows the shares of unskilled workers by sector (see also Table A11 in the Appendix). A prudent conclusion (with the above allocation of labourers in mind) is that the deskilling that occurred *before* the Industrial Revolution (i.e. between 1500-99 and 1700-24) was mainly in *primary* activities, and the deskilling that was occurring *during* the Industrial Revolution (between 1700-24 and 1825-50) was mainly in *secondary* activities. The share of unskilled workers in the tertiary sector remained largely constant (at about 1%) during the entire period.

[6] The eight parishes are Willingham, Great Oakley, Terling, Aldenham, Ash, Hartland, Morchard Bishop, and Bridford.

**Figure 11**

The Share of Unskilled Workers by Sector, 1550-1850




*Notes*: The allocation of labourers by sector is described in the text. *Sources*: CAMPOP data (see text); Booth (1886); Broadberry et al (2012); Shaw-Taylor (2012).

Last but not least, our data allow us to dig a little deeper into the occupational structure within the primary and secondary sectors. This can help shed light on the types of skilled professions that were replaced by unskilled professions. It also allows us to explore the idea proposed by Mokyr and others that technical change and the adoption of machinery increased the demand for 'high-quality workmen' such as engineers, mechanics, millwrights, instrument makers, and chemists. According to Mokyr (2009) and Meisenzahl and Mokyr (2012), these professions were necessary to alleviate the technical innovations that the Industrial Revolution entailed.[7] Karine van

[7] This view has received support from Squicciarini and Voighländer (2014) looking at the French Industrial Revolution.

der Beek has already made some headway in this regard; her observation that a growing number of individuals were being apprenticed as wrights, carpenters, joiners and turners between 1710 and 1770 is evidence of the hypothesis of Meisenzahl and Mokyr (van der Beek 2012).

Is it possible to reconcile the hypothesis that the Industrial Revolution was skill demanding with the vast episode of deskilling observed above? To find out, we have classified our occupations into six major groups (see Table A12 in the Appendix). The groups are labourers, agriculturalists, traders, lower-skilled craftsmen, medium-skilled craftsmen, and finally a category consisting of the 'high-quality workmen' identified by Mokyr and others. Labourers include 'Labourer' and 'Day-labourer', both of which are unskilled. Agriculturalists include 'Farmer', 'Yeoman', 'Husbandman', 'Cottager', 'Farm worker', and 'Farm servant'. Farmers and yeomen are medium-skilled; husbandmen and cottagers lower-skilled; and farm workers and farm servants unskilled. Traders include 'Merchant', 'Retail trader', and 'Wholesale trader', all of which are deemed medium-skilled professions in the HISCLASS scheme. Craftsmen comprise a variety of different occupational titles largely concerning the same work. Weavers are a good example. This profession covers cloth-, lace-, gorter-, serge-, cord-, jersey-, linen- and silk-weavers, all of which we catalogue as 'weaver'. Furthermore, we distinguish between low-skilled and medium-skilled craftsmen. Low-skilled craftsmen include 'Weaver', 'Tanner', 'Glover' and 'other' (meaning 'Product finisher', 'Washer', 'Cutter' and 'Pattern maker'). Medium-skilled craftsmen include 'Tailor', 'Cooper', 'Shoemaker' and 'Smith'. Finally, we include those professions that Meisenzahl and Mokyr (2011) define as 'high-quality workmen' meaning 'Carpenter', 'Joiner', 'Wright', 'Turner', and 'Machine maker'.

**Table 3**

Shares of Workers by Professional Groups, 1550-1850

| Groups | Occupational Titles | 1550-99 | 1600-49 | 1650-99 | 1700-49 | 1750-99 | 1800-50 |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| **Labourers** | (Day)-labourer | 14.2 | 16.7 | 16.7 | 24.2 | 22.7 | 33.4 |
| | | | | | | | |
| **Agriculture** | Farmer and Yeoman | 6.4 | 6.7 | 5.8 | 5.6 | 5.2 | 5.1 |
| | Husbandman, cottager | 10.2 | 11.3 | 6.6 | 6.9 | 4.5 | 1.7 |
| | Farm worker | 0.1 | 0.0 | 0.3 | 0.3 | 0.2 | 0.7 |
| | Farm servant | - | - | - | 0.9 | 1.5 | 7.1 |
| | Total | 16.7 | 18.1 | 12.6 | 13.7 | 11.4 | 14.6 |
| **Trades** | Wholesale trader | 0.3 | 0.6 | 0.5 | 0.2 | 0.2 | 0.2 |
| | Merchant | 1.7 | 1.3 | 1.7 | 1.3 | 0.5 | 0.6 |
| | Retail trader | 3.0 | 4.0 | 3.1 | 2.0 | 2.1 | 2.0 |
| | Total | 4.9 | 5.9 | 5.4 | 3.5 | 2.9 | 2.8 |
| **Craftsmen: Low-skilled** | Weaver | 4.6 | 3.5 | 3.0 | 3.6 | 3.7 | 2.2 |
| | Tanner, currier, dyer | 2.7 | 3.0 | 2.4 | 1.9 | 0.9 | 0.5 |
| | Glover | 1.8 | 2.1 | 0.9 | 0.8 | 0.4 | 0.1 |
| | Other | 0.7 | 0.7 | 1.2 | 0.7 | 0.9 | 0.5 |
| | Total | 9.9 | 9.2 | 7.5 | 7.0 | 5.8 | 3.2 |
| **Craftsmen: Medium-skilled** | Tailor | 6.3 | 5.5 | 4.5 | 4.0 | 3.2 | 2.8 |
| | Shoemaker | 4.4 | 4.8 | 4.2 | 3.7 | 4.4 | 3.9 |
| | Smith | 4.1 | 3.7 | 3.6 | 2.7 | 2.7 | 2.3 |
| | Total | 14.7 | 14.0 | 12.3 | 10.5 | 10.3 | 8.9 |
| **'High-quality workmen'** | Carpenter, joiner | 3.3 | 3.2 | 4.2 | 3.9 | 4.1 | 3.7 |
| | Wright, turner | 0.7 | 0.7 | 1.1 | 0.9 | 1.0 | 1.2 |
| | Total | 3.9 | 3.9 | 5.2 | 4.9 | 5.1 | 4.9 |
| | | | | | | | |
| | Total share of sample | 64.4 | 67.8 | 59.8 | 63.8 | 58.2 | 67.8 |
| | | | | | | | |

*Note*: Carpenters are categorised as medium-skilled workers in the HISCLASS scheme. The reason they nevertheless appear in the group of 'highly-quality workmen' is because Mokyr (2009) and Meisenzahl and Mokyr (2011) deem them important to the Industrial Revolution. *Source*: CAMPOP data (see text).

Table 3 summarises the evolution in the size of each of the seven groups. The Table reveals a strong decline in the shares of lower-and medium-skilled craftsmen between 1550 and 1850, from 25% to 12% of the sampled workforce. The same is true for traders whose share declines from 5% to 3% over this period. These developments happened alongside a staggering rise in the share of labourers: from 14% to 33% across the three centuries. The latter episode occurs in two major steps: from 17% in the latter

half of the 17th century to 24% in the early 18th century, and once again from 23% in the latter half of the 18th century to 33% in the first half of the 19th century.

Accompanying this episode of deskilling, interestingly, is a growth in the share of Mokyr's category of 'high-quality workmen'. The change is modest, from 4% up until 1650 to 5% from 1700 on. But even though the share of 'high-quality workmen' remained largely constant after 1700, this would still involve a substantial rise in the absolute number in these professions. The English population grew from 5.2 million in 1700 to 17.3 million in 1850.[8] Five per cent of the population increase would mean some 300,000 *additional* male workers fitting into the category of 'high-quality workmen', hence lending strong support to the ideas raised by Meisenzahl, Mokyr and van der Beek. New occupational titles also enter into our sample after the 1650s, including 'chemists', 'clock-maker', 'engineer', 'engine operator', 'well-diggers', and 'watch-maker'. This provides further support to Meisenzahl and Mokyr's notion that industrialization through mechanisation required a substantial amount of high-quality professionals to assist the process.

By contrast to this, the declining shares of lower- and medium-skilled professions such as 'Tailor', 'Tanner', 'Weaver', and 'Glover' is consistent with the idea that these skills were relatively easy to substitute by means of capital investments. This supports Allen's notion that the high wages paid to skilled workers were a strong incentive to mechanise Britain (Allen 2009). It also motivates the rise of two resistance groups, the Luddites and Captain Swing of the early 19th century, underpinning why skilled

[8] The population data come from Broadberry et al (2012).

workers were afraid that new machinery would make their working skills redundant (Nuvolari 2002).

It is also worth noting that the shift from peasant farming to large-scale capitalist agriculture is also visible in the data. The modest decline in the shares of 'Farmer' and 'Yeomen' (from 6.4% to 5.1% across the entire period) suggests that land became concentrated in the hands of fewer production units, but the virtual disappearance of 'Husbandman' and 'Cottager' from the data (from over 10% to less than 2% across the period) emphasises the massive structural changes happening in English agriculture at the time. Also, the general decline of the share of agricultural professions (from 16.7% to 14.6%), which occurs together with a considerable growth in the size of the English population (and close to no food imports), highlights that the expansion of British agricultural production in this period was achieved using *less* labour (especially since half of the workers engaged in agriculture were servants).

## IV

## Conclusion

Was England's Industrial Revolution mainly skill saving or skill demanding? Previous work has focused on literacy rates and statistics about apprenticeships to measure the formation of human capital during England's Industrial Revolution. Some of these measures are arguably very crude proxies for the acquisition and (even more so) the application of working skills in productive activities. Apprenticeship contracts, although they certainly capture a substantial investment in individual human capital, concern only a very limited share of the population after all.

We propose a new approach to quantifying human capital used in productive activities, employing the HISCLASS scheme to derive information from historical occupational titles about the evolution in the share of unskilled workers in England between 1550 and 1850. We find that, while the sampled workforce was rather well educated before 1700, the growth in GDP per capita in England after 1700 was accompanied by a substantial episode of deskilling captured by a large rise in the share of workers deemed 'unskilled' by the HISCLASS scheme.

We find that some of the deskilling took place in the industrial sector during the classical years of the Industrial Revolution (c. 1750-1850) and some in the agricultural sector before the Industrial Revolution (i.e. between 1550 and 1750). But the shift from skilled to unskilled work is not the only gloomy conclusion to emerge from our study of English occupational titles across the three centuries leading us through to the end of the Industrial Revolution. Our analysis also supports the Marxist idea of proletarianization, i.e. the social process whereby people move from being either an employer or self-employed to being employed in wage labour by an employer. In combination, these conclusions provide ample evidence of downward social mobility among the English workforce during the early modern period (Thompson 1963; Shaw-Taylor 2012).

The fact that the massive episode of deskilling occurred along with a modest rise in the share of 'high-quality workmen' commonly thought necessary to facilitate the mechanical changes taking place during the Industrial Revolution is not only a compensating fact. It also squares with the theory proposed by O'Rourke et al (2013) showing how technical progress during the early stages of industrialization can be skill

saving and skill demanding at the same time, and with work by Squicciarini and Voighländer (2014) documenting that the French Industrial Revolution was not achieved by an accumulation of skills among the average worker, but by the ingenuity and technical ability of a minority.

Our findings unify many of the sometimes contrasting views about the evolution of human capital during the Industrial Revolution. Our work lends support to the Goldin-Katz hypothesis that the shift from artisan workshops to factory production made craftsmanship redundant by replacing artisan skills with unskilled labour (Goldin and Katz 1998). This was what motivated the rise of the Luddites, a group of machine-breaking artisans formed in the early nineteenth century by Ned Ludd, who rebelled against the mechanisation they felt were making their working skills unnecessary (Nuvolari 2002). Our findings also support the Meisenzahl-Mokyr idea that high-quality workmen were in growing demand during the Industrial Revolution (Meisenzahl and Mokyr 2012) and van der Beek's demonstration that the number of apprenticeships among these professions increased during the eighteenth century (van der Beek 2012). But the episode of deskilling we observe also chimes with Wallis' work showing that many apprentice contracts ended before the term of service was finished (Wallis 2008).

Overall, our conclusions reinforce the pessimistic interpretation of the influence of the Industrial Revolution on living standards in England at the time: working hours went up (Voth 1998, Allen and Weisdorf 2011); child labour increased (Humphries 2010); heights declined (Cinnirella 2008); and wages stagnated (Clark 2007). The rise in the share of unskilled professions after 1700 contributed to a much less stimulating work-life among the majority of English workers.

## References


Allen, R.C. (2009), 'Engels' pause: technical change, capital accumulation, and inequality in the British Industrial Revolution,' *Explorations in Economic History* 46, pp. 418-435.

Allen, R.C., and J. Weisdorf (2011), 'Was there an "industrious revolution" before the Industrial Revolution? An empirical exercise for England, c. 1300–1830,' *Economic History Review* 64, pp. 715–729.

Boberg-Fazlic, N., P. Sharp, and J. Weisdorf (2011), 'Survival of the richest? Social status, fertility and social mobility in England 1541-1824,' *European Review of Economic History* 15, pp. 365–392.

Booth, C. (1886), 'Occupations of the people of the United Kingdom,' *Journal of the Statistical Society of London* 49, pp. 314–444.

Broadberry, S.; B. Campbell; A. Klein; M. Overton; B. van Leeuwen (2011), 'British economic growth, 1270-1870: an output-based approach,' *University of Kent Studies in Economics Working Paper* No. 1203.

Cinnirella, F. (2008), 'Optimists or Pessimists? A Reconsideration of Nutritional Status in Britain,' *European Review of Economic History* 12, pp. 325–354

Clark, G. (2007), *A farewell to alms: A brief economic history of the world*, Princeton, Princeton University Press.

Clark, G. and G. Hamilton (2006), 'Survival of the richest: the Malthusian mechanism in pre-industrial England,' *Journal of Economic History* 66, pp. 707-736.

de Pleijt, A.M. (2014), 'Human capital and economic development in England, 1300-1900,' Utrecht University CGEH Working paper No XXX.

Galor, O. (2011), *Unified Growth Theory*, Princeton: Princeton University Press.

Goldin, C. and L. Katz (1998), 'The origins of technology-skill complementarity,' *Quarterly Journal of Economics* 113, pp. 693-732.

Humphries, J. (2010), *Childhood and child labour in the British Industrial Revolution*, Cambridge: Cambridge University Press.

Humphries, J. (2013), 'Childhood and child labour in the British Industrial Revolution,' *Economic History Review*, 66, pp. 395-418.

Kirby, P. (2005), 'A brief statistical sketch of the child labour market in mid-nineteenth century London,' *Continuity and Change*, 20, pp. 229-246.

Lindert, P. H. and J.G. Williamson (1982), 'Revising England's social tables, 1688-1812,' *Explorations in Economic History* 19, pp. 385–408.

Leunig, T. and C. Minns, and P. Wallis (2011), "Networks in the premodern economy: the market for London apprenticeships, 1600-1749", *Journal of Economic History* 71, pp. 413-443.

Mitch, D. (1999), 'The role of skill and human capital in the British Industrial Revolution,' in *the British Industrial Revolution: An Economic Perspective*, ed. Joel Mokyr, Boulder, Colorado: Westview Press, pp. 241-279.

Mitch, D. (2004), 'Education and skill of the British labour force.' in *The Cambridge economic history of modern Britain*, Volume 1, Floud, R. and Johnson, P. (eds.), Cambridge: Cambridge University Press, pp. 198-259.

Meisenzahl, R. and J. Mokyr (2012), 'The rate and direction of invention in the British Industrial Revolution: Incentives and institutions.' in The rate and direction of incentives and institutions, Lerner, J. and Stern, S., (eds.), NBER books, pp. 443-479.

Mokyr, J. (2009), *The enlightened economy: An economic history of Britain, 1700-1870*, London and New Haven: Yale University Press and Penguin Press.

Mokyr, J. and H.-J. Voth (2009), *Understanding Growth in Early Modern Europe*, in S. Broadberry and K. O'Rourke (Eds.), *The Cambridge Economic History of Europe*, Cambridge: Cambridge University Press.

Newton, G (2007), 'Families reconstituted from data drawn from the parish registers of the parishes of St James Clerkenwell and St John Clerkenwell, c.1550 to 1753,' available at: http://sas-space.sas.ac.uk/749/.

Newton, G. and P. Baker (2007), 'Families reconstituted from data drawn from the parish registers of the five Cheapside sample parishes, c.1540 to 1710,' available at: http://sas-space.sas.ac.uk/748/.

Nicholas, S. J. and Nicholas, J. M. (1992), 'Male literacy, 'deskilling', and the Industrial Revolution,' *Journal of Interdisciplinary History* 23, pp. 1-18.

Nuvolari, A. (2002), 'The 'machine breakers' and the Industrial Revolution,' *Journal of European Economic History* 31, pp. 393-426.

O'Rourke, K.H., A.S. Rahman, and A.M. Taylor (2013), 'Luddites and the demographic transition,' *Journal of Economic Growth* (forthcoming).

Squicciarini, M.P., and N. Voighländer (2014), "Human Capital and Industrialization: Evidence from the Age of Enlightenment," NBER Working Paper No 20219.

Shaw-Taylor, L., E.A Wrigley, P. Kitson, R. Davies, G. Newton, and M. Satchell (2010), "The occupational structure of England, c.1710–1871," *Cambridge Group for the History of Population and Social Structure* Occupations Project Paper No 22.

Shaw-Taylor, L. (2012), 'The rise of agrarian capitalism and the decline of family farming in England,' *Economic History Review* 65, pp. 26-60.

Thompson, E.P. (1963), *The Making of the English Working Class*, Harmondsworth: Penguin.

van der Beek, K. (2012), 'England's eighteenth century demand for high-quality workmanship: Evidence from apprenticeship, 1710-1770,' *Human Capital and Economic Opportunity Working Paper* No. 2013-015.

van Leeuwen, M.H.D., I. Maas, and A. Miles (2007), HISCO. *Historical international standard classification of occupations*, Cornell: Cornell University Press.

van Leeuwen, M.H.D. and I. Maas (2011), HISCLASS. *A historical international social class scheme*, Leuven: Leuven University Press.

Voth, H.-J. (1998), 'The longest years: new estimates of labour input in England, 1760–1830', *Journal of Economic History* 61, pp. 1065–82.

Wallis, P. (2008), "Apprenticeship and training in premodern England", *Journal of Economic History* 68, pp. 832-861.

Wilson, C. (1984), 'Natural fertility in pre-industrial England, 1600-1799,' *Population Studies* 38, pp. 225-240.

Wrigley, E.A., R. Davies, J. Oeppen, and R. Schofield (1997), *English population history from family reconstitution*, Cambridge: Cambridge University Press.

Wrigley, E.A. (2010), 'The PST system of classifying occupations,' Cambridge Univeristy mimeo.

## Appendix

**Table A1**
Examples of Coding of Occupational Titles in HISCLASS

| Skill-level | Occupational Titles |
|---|---|
| Unskilled: | Boatman, chapman, chimney sweeper, clothier, hostler, porter, suckler, warrener, farm worker, factory worker |
| Low-skilled: | Barber, basket maker, brick maker, builder, coachman, carder, cottager, shepherd, dairyman, dyer, fisherman, gardener, weaver, glover, needle maker, painter, thatcher, postman, sawyer, servant, soldier, spinner, stonecutter, turner, clerk |
| Medium-skilled: | Baker, brewer, butcher, carpenter, chandler, cook, clock maker, cutler, dealer, farmer, glazier, innkeeper, maltster, mason, miller, millwright, looker, plumber, printer, saddler, sergeant, shoemaker, smith, tailor, yeoman |
| High-skilled: | Apothecary, attorney, bailiff, captain, chemist, clergyman, doctor, lieutenant, rector, surgeon |

**Table A2**
The Shares of Lower- and Unskilled Workers, Provinces

| | Unskilled | Lower- and Unskilled | N |
|---|---|---|---|
| 1550-99 | 0.21 | 0.53 | 1,215 |
| 1600-49 | 0.21 | 0.51 | 2,773 |
| 1650-99 | 0.23 | 0.50 | 3,273 |
| 1700-49 | 0.29 | 0.57 | 4,688 |
| 1750-99 | 0.32 | 0.59 | 6,606 |
| 1800-49 | 0.39 | 0.64 | 9,592 |
| | | | |
| | | | 28,147 |

**Table A3**
GDP per Capita, Marital Fertility and the Share of Skilled Workers (1550-99 = 100)

| | Per capita GDP | Fertility | Share skilled |
|---|---|---|---|
| 1550-99 | 100 | 100 | 100 |
| 1600-49 | 97 | 97 | 99 |
| 1650-99 | 112 | 97 | 98 |
| 1700-49 | 129 | 104 | 89 |
| 1750-99 | 140 | 111 | 85 |
| 1800-49 | 148 | 115 | 77 |

**Table A4**
The Shares of Lower- and Unskilled Workers, London

| | Unskilled | Lower- and Unskilled | N |
|---|---|---|---|
| 1550-99 | 0.01 | 0.28 | 151 |
| 1600-49 | 0.08 | 0.38 | 181 |
| 1650-99 | 0.11 | 0.41 | 398 |
| 1700-50 | 0.16 | 0.43 | 985 |
| | | | |
| | | | 1,715 |

**Table A5**
The Share of Unskilled Workers: Social Tables and Census Data

| | Unskilled: CAMPOP | N | Unskilled: Social tables | N |
|---|---|---|---|---|
| 1675-99 | 0.25 | 1,824 | 0.29 | 1,390,586 |
| 1700-24 | 0.29 | 2,452 | 0.31 | 1,482,803 |
| 1825-50 | 0.40 | 4,290 | 0.42 | 6,630,700 |

**Table A6**
The Shares of Unskilled Workers, 11 and 25 Parishes

| | Unskilled: 11 parishes | N | Unskilled: 25 parishes | N |
|---|---|---|---|---|
| 1600-49 | 0.23 | 1,986 | 0.21 | 2,773 |
| 1650-99 | 0.24 | 2,129 | 0.23 | 3,273 |
| 1700-49 | 0.30 | 3,040 | 0.29 | 4,688 |
| 1750-89 | 0.32 | 3,856 | 0.32 | 5,151 |
| | | | | |
| | | 11,011 | | 15,885 |

**Table A7**
The Shares of Unskilled Workers, Marriage and Burial Sample

| | Unskilled: Marriage | N | Unskilled: Burial | N |
|---|---|---|---|---|
| 1550-99 | 0.21 | 133 | 0.21 | 610 |
| 1600-49 | 0.21 | 299 | 0.22 | 1,296 |
| 1650-99 | 0.23 | 262 | 0.23 | 1,492 |
| 1700-49 | 0.29 | 643 | 0.26 | 1,955 |
| 1750-99 | 0.31 | 2,268 | 0.28 | 1,924 |
| 1800-49 | 0.41 | 1,954 | 0.33 | 963 |
| | | | | |
| | | 5,559 | | 8,240 |

**Table A8**
The Share of Unskilled Workers and Secondary Schooling (1550-99 = 100)

| | Share Unskilled | Secondary Schooling |
|---|---|---|
| 1550-99 | 100 | 100 |
| 1600-49 | 100 | 118 |
| 1650-99 | 109 | 145 |
| 1700-49 | 138 | 152 |
| 1750-99 | 152 | 113 |
| 1800-49 | 186 | 55 |

**Table A9**
The Share of Workers by Working Skills, White-Collar Workers

| | Low-skilled | Medium-skilled | High-skilled | N |
|---|---|---|---|---|
| 1550-99 | 0.13 | 0.54 | 0.33 | 163 |
| 1600-49 | 0.11 | 0.69 | 0.20 | 371 |
| 1650-99 | 0.11 | 0.67 | 0.22 | 500 |
| 1700-49 | 0.10 | 0.67 | 0.23 | 549 |
| 1750-99 | 0.04 | 0.74 | 0.22 | 652 |
| 1800-49 | 0.06 | 0.70 | 0.24 | 850 |
| | | | | |
| | | | | 3,085 |

**Table A10**
The Share of Workers by Working Skills, Blue-Collar Workers

| | Unskilled | Low-skilled | Medium- | N |
|---|---|---|---|---|

| | | | skilled | |
|---|---|---|---|---|
| 1550-99 | 0.24 | 0.35 | 0.41 | 1,052 |
| 1600-49 | 0.24 | 0.33 | 0.43 | 2,402 |
| 1650-99 | 0.27 | 0.30 | 0.43 | 2,773 |
| 1700-49 | 0.33 | 0.31 | 0.36 | 4,139 |
| 1750-99 | 0.36 | 0.29 | 0.35 | 5,954 |
| 1800-49 | 0.43 | 0.26 | 0.31 | 8,742 |
| | | | | |
| | | | | 25,062 |

**Table A11**
The Share of Unskilled Workers by Sector of Production

| | Primary | Secondary | Tertiary | N |
|---|---|---|---|---|
| 1550-99 | 0.11 | 0.10 | 0.01 | 1,215 |
| 1700-24 | 0.21 | 0.05 | 0.01 | 2,452 |
| 1800-50 | 0.17 | 0.19 | 0.01 | 4,290 |

**Table A12**
Occupations by Professional Categories

| **Group** | **Professions Included** |
|---|---|
| Labourers: | Labourers, day-labourers, factory workers |
| Agriculture: | Farmers, yeomen, husbandmen, cottagers, farm workers, farm servants |
| Trade: | Dealers, chandlers, merchants, sellers, grocers and shopkeepers |
| Craftsmen, Low-Skilled: | Weavers, knitters, spinners, dyers, tanners, curriers, breechesmakers, glovers, cutters, carders, twisters, bleachers, product finishers, (flax)dressers, (textile)washers, and pattern makers |
| Craftsmen, Medium-Skilled: | Tailors, hat makers, stay makers, cobblers, shoemakers, saddlers, harnass makers, smiths, cutlers, knife makers, needlemakers, and engravers |
| 'High-Quality Workmen' | Carpenters, joiners, wrights, turners, wheelmakers, machine makers |