

OCCUPATIONAL STRUCTURE IN ENGLAND AND WALES DURING THE INDUSTRIAL REVOLUTION

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Introduction

0. Introduction. The “industrial revolution” designates a process starting in the mid-eighteenth century, during which England and Wales experienced significant transitions in manufacturing and manufacturing processes and strong economic growth. Helped by a number of new technical inventions – in addition to strong population growth, favourable conditions for commerce, government policies and financial innovations – efficiency in the textile and iron industries increased manifold. Manufacturing moved away from handmade goods and cottage industries into mass production, helping Britain to become a world power. Urbanization changed the face of the country and improvements in agriculture allowed to the growing population to be supplied with food. The industrial revolution has thus had a major historical impact and is seen as crossing a threshold into modern economic growth. It has changed our lives, life expectancy, employment and how we look upon the world. The three chapters of this thesis attempt to better measure the occupational changes in the English and Welsh population during this time period – one of the key characteristics of the industrial revolution.

1. Literature. The Industrial Revolution is well researched; the causes and processes have been greatly discussed, in addition to various analyses of basic national income. An important branch of research has focused on the strength of economic growth, which recent research paints as being slower than originally supposed. Moreover, revisionist social historians assert that “English society before 1832 did not experience an industrial revolution let alone an Industrial Revolution “ (Jonathan Clark, 1986, pp. 39). During the time from 1750 to 1850 the number of patents grew fast as did cotton output; but national income and aggregate consumption grew only gradually.

So national accounts and various local analyses are apparently not enough to answer questions relating to changes in the economy and, in particular, in social structures. In the words of Joel Mokyr (1993, pp. 2), “arguments about what exactly changed, when it started, when it ended, and where to place the emphasis keep raging”. More recent work looks away from national aggregates to focus on regional and industrial aspects of the industrial revolution, emphasizing acceleration in efficiency and output. But again, the main focus is on the sorts of products, their quantity and the production processes. There is so much more to this time period. How did the industrial revolution impact professional and social structures? Do service occupations expand and, if so, in which areas? Which secondary industries employed the bulk of the workforce, and where? What would a national occupational map of this period reveal?

Mokyr (1993) divides research about the industrial revolution into four schools: social change, industrial organization, macroeconomics and technology. Of particular interest is the research on macroeconomics. Important proponents of this school are Deane and Cole (1969), with their estimates of national income and industrial production, as well as the more recent revisionists to economic growth – such as Wrigley (1987) and Crafts and Harley (1985). Crafts and Harley claim that productivity growth was confined

to only a few sectors, such as wool, cotton, iron and machinery, with the remaining sectors experiencing much lower productivity increase. Temin (1997) refutes this view, claiming that foreign trade figures show that Britain remained competitive not only in these industries but also in a range of older industries such as linen, glass, buttons, soap and brewing, amongst others. Thus, claims Temin, efficiency must have improved on numerous fronts. Mokyr (1993) holds that the aggregate effect of the Industrial Revolution before 1820 is not significant but has no numbers to support the claim. He further divides the pace of the economy into two groups: traditional trades such as agriculture, construction, craftsmen and domestic industry; and the modern sectors such as cotton, iron, smelting, chemistry, mining and engineering. The missing piece of the puzzle, however, in the preceding discussion is any quantification of professional occupations and social structures. This is a pre-requisite to understanding how the economy and society were impacted by the fundamental structural changes that occurred. Filling this gap is the aim of this thesis, in the form of creating a national and regional synthetic census for 1801.

From 1801, a decadal national census was taken in Britain. Early versions were rudimentary and the first census with a moderate level of detail was that of 1841. The 1851 census is of superior quality and is frequently used by economic historians as a source to quantify social and professional structures. Comprehensive national and regional tables, with the same structure as the 1851 census, do not exist prior to 1851. However several attempts were made at quantifying occupations. Patrick Colquhoun (1806) approached the task in the midst of the industrial revolution and created social tables using the 1801 census. These incorporate only a few professions for certain regions, and thus suffer from severe limitations and are of limited use for historians.

Lindert (1980) introduced a new approach, using parish registers to quantify occupational structures in the eighteenth and early nineteenth centuries. Even though these are not representative of the population because they are biased (only male professions for certain age groups and for certain congregations are recorded) they nevertheless represent a very informative source compared to the few data available until then. This line of research has been continued recently by the Cambridge Group for the History of Population and Social Structure, led by Wrigley and Shaw-Taylor, which has constructed regional and national tables based on extended sampling of parish registers and militia ballots from the years 1813 to 1820 (thus dating their benchmark to 1817).

The three chapters of this thesis use sampling from trade directories – in combination with several other sources, such as parliamentary reports and farm surveys – as a data source. My research adds several novelties to the discussion of professional and social structures in the industrial revolution. First, the statistics generated here are for 1801, in the middle of the first industrial revolution and almost two decades earlier than the benchmark generated by other scholars. Second, my data includes both men and women of all ages and congregations and is less biased than the sources used in other studies. Finally, the 1851 regional census structure – comprising 369 professional and social titles divided into 17 groups – has been applied to the 1801 tables. This permits direct comparison to the 1851 census on both national and regional levels; this allows for a quantitative flow analysis during from 1801 to 1851, which is the key time frame for understanding the occupational and social process of industrialization.

Data on the business structure of the private, non-agricultural sector are drawn from the *Universal British Directory (UBD)*, which was published in nine volumes between 1793 and 1798. The *UBD* was a combined Yellow Pages and White Pages of its time. It offered very extensive lists of tradesmen in each town, as well as separate sections for gentry, clergy, lawyers, doctors, bankers, the town corporation (i.e. town management), substantial outposts of Government (such as Royal dockyards or the Customs Service) and transport (masters of coaches, barges and locally-based ships). In the case of London, the section on tradesmen alone covers 260 pages and amounts to around 34 000 entries; in the case of Manchester, the section on tradesmen covers 72 pages and amounts to around 8 000 entries; and in the case of Birmingham, the section on tradesmen covers 32 pages and amounts to around 3 200 entries. Smaller towns obviously required fewer pages, with the smallest having as few as one page or a half-page. Each entry in the *UBD* typically recorded the name of the individual (or partnership) and their line of business; in some towns it recorded also the address. It is noteworthy that many individuals and partnerships operated in several lines of business, sometimes up to six, and these were dutifully reported in the *UBD*. The *UBD* covers around 1 600 towns and villages across England and Wales, although for many of the smaller towns it does not record details on the businesses that were in operation. Instead, it simply gives a general description of the place and perhaps details on coach connections and such like. We do not know why the details on businesses were reported for some small towns and not others; as far as we are aware, there is no systematic bias.

2. Method. The first chapter of the thesis proposes a method for constructing synthetic 1801 census tables. Using the 1851 census and contemporary trade directories, it can be shown that it is possible to infer local occupational structure using trade directories with acceptable accuracy. The structure of the historical problem is displayed in table 1 below. The goal is to track occupational change over time using the census but there is no satisfactorily reliable census before 1851. If there is a valid statistical relationship between trade directories from 1851 and the 1851 census, could one use this to create a synthetic census for 1801 by using contemporary trade directories?

Table 1. Data sources available to track occupational change.

1801	1851
?	Occupational census
Trade directory	Trade directory

Trade directories tell us about the number of businesses operating in each occupation, not the number of workers employed. One approach to construct an occupational structure would be to multiply each business by an employment factor that is appropriate to that occupation. The 1851 census can be interpreted as an enormous and completed trade directory for Great Britain as it contains a table of employees per business, broken down by occupation. Dividing the total number of people in each occupation by the average number of employees per business should therefore give the number of businesses in each occupation. That is, it forms a sort of national trade directory. For the trade directories a similar approach can be followed. Divide the census data by the trade directory and thus create a synthetic employment table. This table is

exact, in the sense that it matches the two series perfectly, by construction, so there is now an employee per business table for 1851, which can be used to reflate the register of businesses for 1801. For this to be valid, the weights reflected in the tables must be stable between 1801 and 1851, but even though the establishment size should change during this time period, it will not generate a bias as long as it changes equally over the professions. Using this approach does not give an exact number of observed businesses, but I am not trying to find the *number* of businesses. All I am trying to discover is the *distribution* of businesses (and, from there, the distribution of individuals' occupations).

If the trade directory is a random sample of businesses in a particular town, then a one per cent larger share accruing to a particular occupation in the census will be reflected by a one per cent larger share accruing to that occupation in the trade directory (the coefficient on the census data will be unity). To the extent that there is measurement error in the estimated occupational structure derived from the trade directory, the estimated coefficient in the regression should be biased downwards, for standard econometric reasons. Hence I expect to observe estimated coefficients that are less than unity but hopefully not statistically significantly different from it. I entered data from trade directories around 1851 for nine sample towns and undertook the regression. The distributions of the census and trade directories were fairly similar for each town, and the coefficient on the census was not significantly different from unity and with an acceptable r-squared (see chapter two). These results suggest that the 1851 census can generate an occupational distribution of businesses that mirrors that found in trade directories – both at local and national levels. The results also imply that it is safe to work in the other direction – i.e., infer the occupational distribution that we would observe in the census (if this information had been collected) from trade directories around 1801. I feel that these results are satisfactory and act as a “proof of principle”; occupational structure can be inferred from trade directories.

3. 1801 synthetic national census. Chapter two applies the method outlined above to construct a synthetic census for 1801. A stratified sample of towns is taken from the *UBD* and used to construct estimates of both national and regional business structures, based on the entries for approximately 80 000 individuals operating 100 000 businesses. I then move from business structure to occupational structure using estimates of workers per business establishment. Since the trade directories essentially report only urban data, I supplement these data on industry and services with estimates of agricultural employment (based on the 400 farms surveyed by Arthur Young) and other primary sector occupations (based on various Government enquiries). I also adduce data on the Government sector, which is covered only erratically in trade directories but which turns out to be a crucial consideration. Finally, I estimate the size of the non-working population. The 1801 census provides hard evidence on total population size, so I take 1801 as my benchmark date. Combining all these sources gives a fairly complete picture of the English and Welsh workforce in *c.* 1801, near the beginning of industrialization. Hence I refer to it as a ‘synthetic occupational census’. Since the goal is to track temporal changes in occupational structure, I compare my results from 1801 to the census of 1851, near the end of the first industrial revolution. I ensure that the two cross sections are fully comparable by classifying all the workers from 1801 according to the occupational

classification scheme used in the 1851 census, which is generally accepted as the most complete investigation of occupational structure.

The main finding is that industrial employment increased as Crafts-Harley assumed, and much faster than implied by Kitson *et al.* Industrialization was broad, consistent with Temin’s findings on export growth. In table 2 below I present my results alongside those of Crafts and Kitson *et al.* The Crafts data have been used repeatedly over the last 25 years as a basis for estimating economic growth; the Kitson *et al.* results are very recent and have been causing people to rethink the pace of industrialization. My PST distribution is very close to that proposed by Crafts. I have somewhat fewer workers in agriculture, and correspondingly higher shares in industry and services, but the difference is very small. By contrast, the Kitson *et al.* data show a much higher share of industrial workers already by 1817, and a much lower share of service workers. An important caveat – as Kitson *et al.* state very clearly in their numerous papers – is that their data pertain to males only. Hence their estimates are not strictly directly comparable to the other estimates in table 2.

Table 2. Comparison of estimates of occupational structure.

	1800 (Crafts)	1801 (Brunt-Meidell)	1817 (Kitson <i>et al.</i>)	1851 (Census)
Primary	40	38	38	28
Secondary	30	31	42	41
Tertiary	30	31	19	32

Sources: 1800 – Crafts, *British industrialization*, 62; 1817 – Kitson *et al.*, “Occupational structure”, 10.

I observe a significant increase in the share of industrial employment between 1801 and 1851, up from 31 to 41 per cent. This is similar to the increase postulated by Crafts and Harley, based on the very imperfect data provided by Massie. The industrial increase is matched by the fall in the agricultural share from 38 to 28 per cent. There was also a very slight increase in the service sector from 31 to 32 per cent. Service sector employment was inflated in 1801 by military mobilization, which accounted for 3.5 per cent of total employment. A counterfactual supposing that military enrolment was only 1.2 per cent of total employment (as in 1817) suggests that industrial employment over the period would have risen from 32 to 41 per cent; services would have risen from 29 to 32 per cent; and agriculture would have fallen from 39 to 28 per cent. This increase in industrial employment is only marginally lower than that supposed by Crafts and Harley. Overall, the new employment data provide no motivation to revise substantially the existing estimates of economic growth, nor our understanding of the underlying mechanisms that drove them.

One aspect of industrialization that may need to be revised is industrial concentration during the time. I offer no comment on output or productivity growth but I can say that employment growth in cotton and iron was modest. Employment growth in other sectors was much more quantitatively important (apparel, construction, food and beverages). Most interestingly, there were small contributions from virtually all sectors, showing that industrialization was very broad. This lends support to Temin’s analysis of trade data, where he finds that England increased its exports in a wide range of industries.

4. Regional Specialization. The third chapter takes a complete and quantitative approach to regional and sectoral analysis. For each of the 45 English and Welsh counties, a population breakdown using the structure of the 1851 county tables is made. This classifies the population into 369 occupations in 17 occupational groups. The first step in estimating the 1801 county census consisted of fixing the county populations. The 1801 census itself estimated the total population of England and Wales to be 8 872 980, not including military personnel, seamen and convicts. The population is split into counties and this is the starting point for the regional analysis. The next step is to find the number of military personnel, seamen and convicts – which was large in 1801 – and distribute them across the counties. Parliamentary inquiries give detailed information about defence and seamen; for convicts I lean towards Howard’s prison census from 1776. I do not have any reason to believe that the prison population changed significantly to 1801, so the numbers are simply added. The estimates of these occupations sum to 290 087 persons. Adding these gives a total population of 9 163 067 for England and Wales in 1801, suitably distributed across counties.

The next step consists of deciding how best to estimate the number of persons for each of the 369 occupations in the 1851 county census. Each occupation is attributed to a category based on the data source or method used to estimate the number of workers. Six rules are set up, one for each category. Rule 1 is the simplest. There are five occupations in the 1851 census, which did not exist in 1801, or existed with a negligible number of occupants; these are activities connected with the railway. Hence the estimate for 1801 is nil for each occupation.

Rule 2 incorporates occupations for which I have access to detailed historical sources. Governmental activities (including Customs, Inland Revenue, police and military), fishermen and miners are among the 26 professions listed. The main sources for these are Parliamentary enquiries and reports from 1801 or thereabouts, which give either a detailed list of the incumbents or sufficient information to make an educated guess, both with regards to total employment and the county distribution.

Rule 3 is slightly more complicated. Thirteen of the occupations, and a substantial amount of the population, were in farming. The main source for Rule 3 activities is a survey of 400 farms in *c.* 1770 prepared by Arthur Young. The survey estimates the ratios of farm servants, agricultural labourers, boys and maids to farmed acreage. For 1801, we have estimates of the total of farmed acreage for each county and we also know the total farming population of England and Wales. The average farm size in 1801 was 146 acres. We use these to estimate the county numbers of four occupations related directly to farming for 1801. For the other nine occupations, which are quantitatively small, we apply the same ratio of farmer to the occupation as given in the national census for England and Wales in 1851.

Rule 4 covers 169 occupations, the largest number of activities, and is thus central to the county distributions. Most of the occupations of historical interest are included here, such as cotton manufacturers, weavers, iron manufacturers and woollen cloth manufacturers, to name just a few. I use the *UBD* as my main source and use the method discussed above, but on a county level. Thus for each county, I entered data from the 1851 regional (county) censuses as a starting point and pursued a similar approach to the national tables.

Rule 5 contains occupations for which no sources give satisfactory data. Of the 150 occupations present in this group, 64 belong to the category “other” (such as “Other Teachers”). Each group within each class of the 1851 county census has an occupational title of this type. This was an approach chosen by the census authors to reduce the number of occupations from 1091 to 369, by summing up rare occupations for each group within each category. The best I can do for these is to assume that the ratio to the county population in 1801 is the same as the ratio to the county population in 1851. Obviously, these occupations are numerically unimportant – which is exactly why they were aggregated.

Finally I have five occupations where the number depends on that of another occupation. For example, I take the number of butcher’s wives as a proportion of the number of butchers. For these I apply the same ratio between the two as in the 1851 county census.

When comparing 1801 to the corresponding 1851 census tables, I am able to quantify many of the historical developments found and discussed over the years in the literature on the early industrial revolution. With a notable exception, namely transport, most occupations were more concentrated in 1851 than 1801. For literally all regions, the defence of the country employed fewer people in 1851 than in 1801 (the height of the Napoleonic wars). Although there were relatively fewer farmers in 1851 than in 1801, the counties surrounding London and Lancashire actually became more specialised in farming. The number of mechanics more than doubled and exploded in Lancashire and surrounding counties. Woollen cloth production lost importance and became very heavily concentrated in and around West Yorkshire. Flax and linen manufacture was widespread in 1801, but collapsed before 1851. Cotton manufacture was more labour-intensive but also more widespread in 1801; by 1851 many counties had only negligible production capacity left and Lancashire had gained ground. The overall level of industrial specialisation, on average, remained very stable from 1801 to 1851, but there are important clusters within specific occupations.

Marshall’s (1890) discussion of the concentration of specialized industries into particular localities fits well with the occupational shifts and the regional movements between 1801 and 1851. Marshall noted several causes of the formation of such “industrial districts”. Primary causes are physical and geographical conditions – such as accessibility by land or water, or closeness to minerals and cheap energy (coal). In addition, for a skilled workforce in one particular sector “mysteries of the trade become no mysteries”, as workers in similar and local industries share their experiences, inventions and improvements both “in machinery, in processes and the general organization of the business”. Marshall further holds that improved transport is crucial, as it allows for splitting up processes and locating different stages of production in different places. It allows, for example, certain counties to specialise in food production and others in manufacturing, whilst allowing both to get their essential inputs (food for factory workers, ploughs for farmers). In general, the observed tendencies between 1801 and 1851 follow Marshall’s assertions. Marshall compared the 1851 and 1881 census, and noted that the population moved away from agricultural occupations into mechanical and manufacturing work, but also tertiary engagements such as education, domestic services and building. Very much the same dynamics can be seen from 1801 to 1851. But the period 1801 to 1851 was marked not only by a rapid increase in the national level of

industrialization, but also by the clustering of several important sectors into Marshallian industrial districts. Woollen cloth production centred in and around West Yorkshire, cotton manufacture in Lancashire, flax and linen manufacture in Lancashire and West Yorkshire, lint manufacture in Lancashire, iron manufacture in Monmouthshire, Cumberland and Worcestershire, lace making in Bedfordshire and Derbyshire, earthenware in Staffordshire, button making and nail making in and around Birmingham.

As one would expect, transportation, on the other hand, became more dispersed. Ship-agents, boat and bargemen, ship owners and warehousemen settled along the new transport network. Service professions, such as accountants, barristers and lawyers followed new business and settled to a higher degree outside London; so did Government service workers such as police officers and post offices. Engineering and construction professionals neither concentrated nor dispersed; but the number of workers exploded. Industry needed machines and the workers needed houses. Counties outside the new industrial centres specialized in farming; the counties surrounding London are a good example.

Some of these findings are not new. The concentration of the woollen industry is well documented, for example. But I have found new and reliable sources to quantify this evolution in a detailed and comprehensive manner. Using the *UBD*, and several other sources, I have been able to construct an 1801 regional occupational census with a satisfactory degree of precision and confidence. The numbers confirm developments highlighted in the literature, and this supports the rigor of our tables. However, there are still numerous open questions to be answered by future research. Thus an internet site is accessible at www.1801census.com with all my data tables and details for those who would like to make further analysis.

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*Trade directories as a data source on occupational structure: evidence from England in 1851**

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Abstract

In the absence of occupational census data before 1851, recent research utilizes baptism registers to infer occupational structure in England in 1817. As an alternative source, we propose using trade directories as these seem to be unaffected by many of the fundamental issues stemming from baptism registers. We outline the history of trade directories and detail their construction. Using the 1851 occupational census and contemporary trade directories, we show that it is possible to infer local occupational structure from trade directories with reasonable accuracy. A suitably stratified sample could generate a national occupational distribution. This technique could likely be employed back to 1770.

Keywords: Census, structural change, industrialization.
JEL classifications: J21, N13, O14, Y10.

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0. Introduction. Recent characterizations of the British industrial revolution have played down the rate of economic growth, which is now widely agreed to have been slower than was suggested originally by Deane and Cole.¹ Instead, more emphasis has been placed on the role of structural change, especially the transfer of labor resources from agriculture to industry.² An obvious lacuna in this line of argument is that the available quantitative evidence on the rate or extent of structural change has been weak. The first census did not take place until 1801 and the occupation data that were collected in that year are worthless; households are categorized into three sectors (“Agriculture”, “Industry” or “Other”) and for most counties these sum to something like 50 per cent of the number of households, leaving us to wonder what the rest of the population were doing. Only with the census of 1841 do we get the first reliable estimates of occupational structure; but the 1841 categorization remains primitive and, in any case, by 1841 the first stage of industrialization was almost complete, so those data are not much help in measuring structural change. There have been previous efforts to quantify English social structure in the eighteenth century³; these have formed the basis of important quantitative research.⁴ But social structure is not exactly the same thing as occupational structure (even though the two are linked); and the quantification has been fairly broad brush and based on very imperfect sources.

Recent research by the team at Cambridge led by Shaw-Taylor and Wrigley has used a variety of sources – particularly baptism records and militia ballots – to address this issue. They seem to paint a very different picture to the one to which we are accustomed, with much higher rates of industrialization by 1801.⁵ We discuss their research much more fully in the next section. Overall, we believe that there are significant challenges with their approach and that it is essential to consider the evidence of alternative sources. Trade directories contain large amounts of contemporary data on economic and employment structure and offer a potentially fruitful line of enquiry. Trade directories are a well-known source for historians but there seems to have been no attempt to harvest them for large-scale quantitative analysis. The purpose of this paper is to assess the possibilities of such a line of research and consider the difficulties that it poses. We therefore undertake a detailed comparison of contemporary trade directory data and the 1851 census – the first census for which there are really detailed occupational data. We show that trade directories do seem to offer a reliable guide to occupational structure, when handled with suitable care. This could perhaps push our knowledge of occupational structure back from 1851 to 1770.

In the next section we consider the recent research. In section two we outline the history of trade directories and consider why and how they were compiled. In section three we undertake the comparison of trade directories and the 1851 census. Section four concludes.

¹ Deane and Cole, *British economic growth*; Crafts and Harley, “Output growth”; Antràs and Voth, “Factor prices”.

² Crafts, *British economic growth*.

³ Lindert and Williamson, “Revising”.

⁴ Crafts, *British economic growth*.

⁵ Kitson et al., “Creation of a ‘census’”; Shaw-Taylor *et al.*, “Occupational structure”; Wrigley, “PST system”.

1. Baptism records. From 1813 onwards, the registration of a baptism by the Church of England required the recording of the occupation of the father. For the period 1813-20, Kitson *et al.* took paternal occupation data from all extant registers (around 11 000) across England; for smaller parishes the population of registrations was entered, whereas sampling was used for larger parishes. These reported paternal occupations were used to infer occupational structure. Note that there are a number of sample selection issues here, some of which are discussed by Kitson *et al.*. Most obviously, the data pertain to males only, an important caveat that Kitson *et al.* state very clearly in their numerous papers.⁶ If males were employed systematically in different occupations – which seems highly likely – then the occupational distribution of males would not be a good guide to the overall occupational distribution. It is also problematic that many people were not Anglicans by this date – perhaps belonging instead to a dissenting Protestant church or the Catholic Church – and thus will not appear in the baptism sample. Various occupations – such as the law, the military and the Church of England – were off limits to people who were not members of the Established Church; therefore Dissenters must have had a different occupational distribution. There are several, rather more subtle, sample selection issues that we discuss below.

In table 1 we present the occupational structure estimates of Kitson *et al.*, based on baptism registers, alongside those adopted by Crafts for 1801 and those available from the 1851 census. The Crafts data have been used repeatedly over the last 25 years as a basis for estimating economic growth; they show a very significant shift of labour resources out of the primary sector (agriculture, in fact) into the secondary sector. By contrast, the Kitson *et al.* data show a much higher share of industrial workers already by 1817, and a much lower share of service workers. This paints a very different picture of the rate of industrialization to that proposed by Crafts (and, later, Crafts and Harley).⁷ Kitson *et al.* find very little trace of industrialization in the early nineteenth century. Instead they find a Commercial Revolution, with a dramatic relative shift of employment out of agriculture and into services. Of course, their estimates are not strictly directly comparable to the other estimates in table 1 because they are based on male occupations only; some kind of correction would need to be made to generate a consistent series, although we are not in a position to say what the nature of that correction would be. Overall, we would say that either baptism registers must revolutionize the way that we think about British industrialization, or else we must have serious concerns about the validity of using them to infer occupational structure. We incline towards the latter point of view.

Table 1. Comparison of estimates of occupational structure.

	<i>1800</i> <i>(Crafts)</i>	<i>1817</i> <i>(Kitson et al.)</i>	<i>1851</i> <i>(Census)</i>
Primary	40	38	28
Secondary	30	42	41
Tertiary	30	19	32

Sources: 1800 – Crafts, *British industrialization*, 62; 1817 – Kitson *et al.*, “Occupational structure”, 10.

⁶ Kitson *et al.*, “Creation of a ‘census’”.

⁷ Crafts and Harley, “Output growth”.

Now we must ask what conditions Kitson *et al.* require for their inferences about occupational structure to be valid. There are two highly important ones.⁸ First, it must be the case that representatives of all occupations were equally likely to marry and procreate. This is clearly false. The likelihood of marriage was obviously related to income – paupers, prisoners and the laboring poor (for example) would be less likely to marry than industrial workers. But the situation is more complicated than this because there are both lifestyle and lifecycle considerations. It seems plausible that males in some occupations would be systematically less likely to marry and procreate – such as merchant seamen who were away on long voyages, members of the Catholic clergy and faculty members of Oxford and Cambridge. Inferring the proportion of these men in the population on the basis of the frequency with which they appear in baptism registers seems hazardous because their lifestyle makes procreation less likely. Consider also the case of soldiers and Royal Navy personnel. Since they were abroad for years on end, one might conclude that they are in the same situation as merchant seaman. But this is rather a problem of *lifecycle* than of *lifestyle*. Most soldiers were young; most fathers were older. It may be the case that many of the males in the baptism register sample were *formerly* soldiers; but they are unlikely to be soldiers at the point in time when we observe them having children. Therefore occupations that were disproportionately filled by young people – who later moved on to another type of work – will be systematically under-represented in the baptism registers. Agricultural and other labourers occupies a significant share of the samples in Kitson *et al.* and thus represents an important source for errors. Note, in passing, that all the examples we have listed fall within the service sector – this will be of some importance in the following discussion.

There are also problems with multiple occupations. Many people had multiple occupations in the early nineteenth century and the question arises as to which occupation a father would offer if only one were recorded. If undertakers were commonly carpenters as well, then one could imagine that there may well be a systematic preference for reporting carpenter in preference to undertaker (or wagoner in preference to night soil collector, and so on). Kitson *et al.* discuss the assumption of equal marriage and fertility rates at some length and try to correct for the fact that it is violated, for example by adding extra laborers to their estimates. But their corrections are rather *ad hoc* and clearly extremely incomplete.

Second, Kitson *et al.* require that male completed fertility (that is, the total number of children produced per man) was the same for men across all occupations. We find this second condition – which Kitson *et al.* assume to be true – to be strong, surprising and unnecessary for the following reasons. It is a strong assumption in the sense that small violations have a large impact on the estimated occupational structure. Suppose that we sample four baptism records and find that two fathers are recorded as agriculturalists and two as industrial workers. Kitson *et al.* then infer that there were two agricultural workers and two industrial workers in the workforce (an industrial share of 50 per cent). Now suppose that each agricultural worker had one child and each industrial worker had two children in their lifetime. Then, of course, there would really be two agriculturalists but only one industrial worker in the workforce (an industrial share of 33 per cent). As we sketch in table 2 below, small variations in completed fertility across occupations could change Kitson *et al.*'s estimates of occupational structure drastically.

⁸ As they note – Kitson *et al.*, “Occupational ‘census’”, 3-4.

Kitson *et al.* observe the data in column 2 of table 2 and assume a one-to-one mapping to the number of fathers, thus generating column 3 and therefore column 4. Now suppose instead that the completed fertility of service sector families (such as merchant seamen and soldiers) were one third lower than average, and the completed fertility of industrial families one third higher, as inscribed in column 5. Then the observations in column 2 map instead to the number of fathers in column 6, and then on to the occupational structure of column 7. But columns 7 and 4 in table 2 are simply a restatement of columns 2 and 3 in table 1. Thus differential fertility rates could easily transform the estimates of Kitson *et al.* into the estimates of Crafts. In reality, we do not need to make such an extreme assumption as a one third difference in sectoral fertility rates. If we admit that Crafts' estimates may be slightly out; and that there may have been some change already between 1800 and 1817; and if we allow for the fact that Kitson *et al.* consider only males; then a smaller assumed differential in fertility would be able to reconcile the two sets of numbers. But this need not lead to wholesale revisions of Crafts' position, nor of his description of the pattern of industrialization.

Table 2. Possible effect of variations in occupational fertility.

1	2	3	4	5	6	7
	<i>Observed Baptisms</i>	<i>Inferred Number of Men (Kitson et al.)</i>	<i>Inferred Occupational Structure (Kitson et al.)</i>	<i>Hypothesized Occupation-Specific Fertility</i>	<i>Inferred Number of Men</i>	<i>Inferred Occupational Structure</i>
Primary	1.15	1.15	38	0.95	1.21	40
Secondary	1.25	1.25	42	1.35	0.93	30
Tertiary	0.60	0.60	20	0.65	0.92	30

Sources: see text.

We have now explained why we find the assumption of no variation in fertility across occupations to be strong. We find it also surprising because our understanding of the literature on English population growth is that a significant part of it was due to the movement of the workforce into industry. Changes in population growth between 1716 and 1816 were driven by changes in fertility; and changes in fertility were driven by changes in nuptiality, particularly the decline in the average marriage age of women by three years.⁹ Earlier marriage led to higher completed fertility (more children per woman) because the number of births per women was largely determined by the number of years of marriage of fertile women. Industrial workers married earlier because they reached their peak earnings at a younger age; thus industrial workers had higher completed fertility than agricultural workers and the move into industry accelerated population growth. If this story were true then surely we should expect to see higher completed fertility for industrial workers in 1801 also? If we would accept this assumption, that would explain why Kits *et al* conclude with a secondary employment of 42% in 1817. This is higher than in 1851 (41%) and a significant higher level than Crafts estimation of 30% in 1801. In such circumstances, the contrary assumption – that completed fertility was the same across occupations – would not be innocuous.

We are also puzzled as to why Kitson *et al.* need to make this assumption at all. They entered all the available baptismal records. Since the name of the father is noted on

⁹ Schofield, "British population change", 73-81.

the record, they could simply count the total number of children produced by each man in the sample. Since they know also his occupation, they could work out total fertility rates for each occupation. There are certain statistical complications involved in this exercise but – given the large size of their sample – they should be able to get precise estimates. This is an important issue to be resolved.

In general, Kitson *et al.* work at quite a high level of aggregation. That is, their results are presented for large geographical areas; occupations are highly aggregated, from 14 570 into only 113 occupations; and they pool data from many years. They note that some degree of aggregation is necessary because baptisms occur sufficiently infrequently that this generates small sample problems. This seems to be a significant drawback of using baptism records – there are not enough data to provide a really detailed picture.

Overall, we do not find any inexplicable inconsistencies between Crafts' data and those of Kitson *et al.*. Plausibly adjusting their data for differential fertility rates across occupations, the absence of women, and other sample selection issues, could reveal two estimates of occupational structure that are very similar. Since the two estimates anyway pertain to benchmark years that are 16 years apart, we certainly could not say that the two estimates are substantially different. Whether they are statistically significantly different is also impossible to say, since Kitson *et al.* do not provide confidence intervals for any of their estimates.

We stress that the primary purpose of this paper is not to provide a detailed critique of the research of the Cambridge team; we have not examined their sources and methods in sufficient detail to pass judgment. Rather, we seek to make the following points in our discussion of their research. First, the headline figures produced by Kitson *et al.* seem quite at variance with Crafts, whose figures were previously generally accepted. Second, the differential could be due largely to (unmeasured) differential fertility rates, the exclusion of women and sample selection. Third, an alternative data source exists that is abundant, not subject to these biases, and has not previously been employed – namely, trade directories. Therefore, it seems sensible to see if the trade directory data can be harnessed to generate reliable estimates of occupational structure. That is the purpose of this paper.

2. History of trade directories. Samuel Lee prepared the first British trade directory in 1677, but the entries covered only 1 953 wholesale merchants living in London.¹⁰ It seems to have met with limited success, since the exercise was not repeated until Henry Kent produced a new directory in 1734. Kent followed the same format as Lee but included 693 fewer names – so either London had shrunk or Kent's directory was very incomplete, the latter seeming more plausible. Coverage seems to have improved over the first few editions (up to 2 006 entries in 1740) but Kent's ambitions remained very limited in his subsequent annual revisions. Osborn's London directory first appeared in 1740 and offered a wider range of information, but was seemingly still very incomplete. The bar was raised in 1763 with the appearance of Mortimer's *Universal Directory*. He included not only the merchants and bankers of London but also people in other trades and professions: artists, musicians, doctors, lawyers, booksellers, shopkeepers and so on.

¹⁰ This paragraph is based on Goss, *London directories*, 1-35.

By the early nineteenth century, the Post Office directory, which first appeared in 1800, was listing around 11 000 entries; and Johnstone's 1817 directory was up to 27 000.

Importantly, Sketchley produced a directory for Birmingham in 1763 – the first for a town outside London.¹¹ The first two editions of Sketchley's directory have not survived but the third edition (1767) has a format very similar to Mortimer's *Universal Directory* for London. Directories soon appeared for many other towns around England and thus trade directories could potentially constitute a very useful quantitative source on English economic history from 1763 onwards. Between 1763 and 1790, up to 50 new directories were produced. These covered ten towns and some also attempted to cover larger areas, with county directories appearing for Hampshire (1784) and Bedfordshire (1785). William Bailey, in 1784, was the first to attempt a national directory that covered the principal towns throughout the kingdom. Wilke's *Universal British Directory*, which appeared in eight volumes between 1791 and 1798, raised the bar again by including also many smaller towns.

In the early nineteenth century, town and county directories became common. In total, Norton's exhaustive survey counts 878 provincial (i.e. non-London) directories published before 1856. Many of these directories are readily available in electronic format because they are of interest to geneologists; therefore they constitute one of the most accessible historical sources. Over time, directories became more thorough and complete and were produced to a higher standard. Famous names – such as Pigot's and White's – started to appear in the 1810s; they set out to cover the whole country both systematically and repeatedly. From the perspective of the economic historian, repetition is a key ingredient. First, it may enable us to trace changes over time using a consistent source. Second, it probably generates a more accurate directory. How does repetition increase accuracy? The directory producer had an extra incentive to ensure that his directory was accurate because he had a reputation to maintain to generate future sales. He also had experience of producing directories and thereby a better idea of how to elicit accurate information (as we discuss further below). Finally, the directory producer already had local knowledge when preparing his directory (i.e. the data base generated by the previous edition).

The issue of accuracy is, of course, crucial in historical enquiry. First consider what we mean by accuracy. It is obviously not the case that the entire population was listed in a trade directory. Poor people would not have been listed; nor would many better off people who were not involved in trade (for example, retired people or military officers or noblemen). In fact, it is highly unlikely that even all the traders were recorded. There may be systematic omissions – such as dung collectors, who might not have wanted to advertise their trade – as well as random omissions and errors. In that sense, the directories are incomplete. But this does not make the directories useless. If we want to track accurately economic changes over time, or map variations across the country, then we do not necessarily need a complete register of all traders and producers. What we desire is transparency and, preferably, consistency. If we know the likely sources of error, so that we can correct for them; and if we know that these remained fairly constant over time; then we may be able to say something worthwhile about changes or variation in economic structure.

¹¹ This paragraph is based on Norton, *Guide*, 1-15.

So how did directory producers compile their data? Several approaches seem to have been adopted.¹² Early producers, such as Bailey and Pye, claim to have visited every house in the locality to elicit information from the householder. Pye, in fact, states that he gave up this approach in his later directories because it was too expensive, which sounds plausible. It may also have been counterproductive because people knocking unexpectedly at the door and asking about the nature of the householder's business might be suspected of being tax collectors – and therefore lied to, or told to go away. In any case, personal interview could not have been a practical mode of compiling county or national directories because the task was simply too vast for a private entrepreneur. Thus it became common to use local agents to collect information.

How could the directory producer ensure that the data he received from local agents were accurate? Wilkes partially solved this problem in the *Universal British Directory* by enlisting local printers and booksellers as his agents; since they were then remunerated in the form of offprints for local sale, they had a stake in generating an accurate product. Logically, the first thing that a potential purchaser would examine to gauge the accuracy of a national directory would be his own town: if it were accurate then he might be willing to believe that the rest of the directory were accurate; if it were not then it would be difficult for the local bookseller to persuade him otherwise. Thus each local bookseller was likely to be able to retail his free offprints of the national directory only if he did a good job of collecting the data in his own town.

Another innovative approach was crowdsourcing. A draft of the local directory was left with a prominent resident of the town and people were asked to inspect and correct it; perhaps this is where Jimmy Wales got the idea for Wikipedia. Traders and professional people had an obvious incentive to ensure that the information about them was accurate and up to date. Not only might this attract business from out of town but one could also imagine that there was a certain cachet derived from being in the directory. In the nineteenth century a class of professional directory agents evolved, who presumably varied in quality – and needed to be monitored – just as other professional workers did (and still do today).

The overall impression is that the quality and completeness of trade directories varied enormously. This probably depended on the integrity of the producer and may also have depended on the target audience. For example, Wilkes' *Universal British Directory* contains a short (or sometimes rather long!) description of the setting and history of each town. This would be particularly useful for someone travelling who wanted to plot an interesting route. These people were then likely to observe firsthand the quality of the directory because they would see how well the directory matched reality. By contrast, the Post Office *London Directory* was intended primarily for people sending letters, which might or might not arrive. A letter might go astray – or elicit no reply – for many reasons; or the postman might manage to deliver the letter even with a wrong address; so the user of the directory had no obvious way of assessing the accuracy of the directory.¹³

¹² These are discussed in Norton, *Guide*, 16-18.

¹³ In the early nineteenth century the cost of postage was paid by the recipient, rather than the sender, so postmen were highly motivated to ensure that the letter reached its destination – even if the address were not accurate. Payment by the recipient obviously gave the postman the correct incentives to handle the mail carefully and promptly; otherwise postmen would have had an incentive simply to store bags of undelivered mail in their lofts, as they do today.

Thus considerable caution is warranted when using trade directories as a source. Consistency is probably more easily attained than accuracy. Depending on the historical issue being addressed, consistency may be a sufficient characteristic to ensure valid inference. Thus using the same directory for one place over time (such as multiple editions of Pigot’s or White’s), or using one directory that covered the whole country at a certain point in time (such as Wilke’s *Universal British Directory*) are likely to be the two most trustworthy strategies. It also seems likely that earlier directories will be less accurate and complete than later directories – there was less competition to provide directories, a smaller database on which to build, less experience of eliciting accurate information and less infrastructure on which to rely (such as professional directory agents).

3. Testing trade directories against the census. The structure of the historical problem that we need to solve is sketched in table 3 below. We would like to be able to track occupational change over time using the census but there was no occupational census before 1851. We would therefore like to create a synthetic occupational census for earlier years using some other source. Since we have trade directories for 1770 and 1851 – and, indeed, at numerous intermediate dates – they are a potentially valuable source if we could harness them correctly.

Table 3. Data sources available to track occupational change.

1770	1851
?	Occupational census
Trade directory	Trade directory

Is it possible to move from trade directories to an occupational census with a sufficient degree of accuracy to make the exercise worthwhile? What are the difficulties that we face? The first problem is that trade directories tell us about the number of businesses operating in each occupation, not the number of workers employed. We will therefore need to multiply each business by an employment factor that is appropriate to that occupation. Note, however, that this procedure is strength as well as a weakness. When we multiply by employees per business, we implicitly include women as well men and those not affiliated to the Church of England.

The second problem is that the likelihood of a business appearing in the trade directory might be a function of its occupation. For example, it is plausible that businesses dealing directly with consumers (say, tailors) made sure that they were listed in the directory to obtain essential publicity, whereas businesses dealing with other businesses (say, ironworks) could successfully establish a reputation by word of mouth. If this were true then – even if we knew the average number of employees for each type of business – we would still not be able to estimate accurately the occupational structure of the population because we would have the wrong distribution of businesses across occupations.

We can lay these fears to rest using matched occupation and trade directory data from 1851. Logically, it should be possible to interpret the 1851 census as an enormous and complete trade directory for Great Britain. How? The 1851 census contains a table of

employees per business, broken down by occupation.¹⁴ Dividing the total number of people in each occupation by the average number of employees per business (in that occupation) should give the number of businesses in each occupation. That is, it forms a sort of national trade directory for Great Britain (albeit a trade directory with the street addresses and names of the businesses removed, which anyway are of no interest to us at this point). Census data are reported for each county and also major towns, as well as nationally; so it can be matched to town-level trade directories the we get a much finer geographical coverage than is possible with baptism records.

Of course, the procedure turns out to be rather more complicated than this. First, the 1851 table of employees per business enumerates only those businessmen (“Masters”) who have more than zero employees (“Journeymen and Apprentices”). So we have to infer how many businessmen there were who had zero employees. In principle, this is straightforward because, for each occupation, the table reports the number of employers having a particular number of workers. If we were to multiply all the employers in an occupation by the number of workers that each of them employed, then we should get the total number of people working in that occupation *except those businessmen who employed zero*. We could then compare this number to the total number of people recorded in the census as having that occupation. Any difference should (in theory) be composed of businessmen who had zero employees. The first problem with this exercise is that the number of employees is given only within certain bounds (1, 2, 3, ... 10-19, 20-29, ... 50- 74, ... 75-100, ... 350 and over). We address this problem by assuming that – on average – each firm was located mid-way between its particular set of bounds. For example, we assume that firms in the 10-19 category employed 15 workers; this is the most plausible assumption and – in expectation – will minimize the magnitude of any error.

The second problem is that most occupations have a very large discrepancy between the two estimates of total workers (i.e. the estimated number of workers employed is much lower than that enumerated in the census). This implies that many occupations had an implausibly high frequency of businessmen who employed zero workers. For example, in order to reconcile the two estimates of the number of people working as bakers, it would have to be the case that 75 per cent of bakers employed no workers. It is possible that 75 per cent of bakers employed no help, but it is not the most plausible suggestion. The census therefore seems to be internally inconsistent.

An explanation for such inconsistency is offered on p. cclxxvi of the 1851 census itself. Many employers neglected to complete the part of the form asking about the number of their employees. This would lead us to incorrectly assume that all the missing bakers (who were not recorded as employees) were sole proprietors with no employees. This would lead us to overestimate the total number of bakery *businesses* in Great Britain. For example, if a baker employed three people but neglected to note this in his census return then those three people would end up be counted as three one-man bakery businesses in our calculations. This could make it impossible for us to match the census with trade directories accurately.

We could therefore make one of two extreme assumptions. Either all the missing people in an occupation were one-man businesses; or all the businesses in that particular occupation employed people in the same size distribution that we observe in the table (i.e.

¹⁴ See British Government, *Census of Great Britain, 1851: Population Tables II*, vol. 1, cclxxvi-cclxxxix.

for those firms that completed the form). This would be correct if some employers randomly neglected to complete that part of the census return. Logically, the truth will lie somewhere between these two extreme assumptions (i.e. there were actually some Masters who had zero employees and there some who neglected to fill in the form). We made all the calculations that follow using both of these alternative, extreme assumptions and found that it made no economically significant difference to our results. How can this be? It is because we are concerned only with the *distribution* of workers across occupations. If the employers in all trades were equally likely to ignore the part of the form dealing with the number of employees (for example, suppose that 50 per cent of all employers failed to complete it) then this will have very little effect on the estimated *distribution* of businesses.

If we make either of these assumptions, can we then accurately derive a national trade directory from the census? We cannot answer this question definitively without compiling all the data from a geographically complete set of 1851 British trade directories – a mammoth task that is far beyond this paper. But we can instead look at a sample of individual towns to shed some light on the issue. As well as giving the national and county data, the 1851 census reports the occupational structure of many English towns. Balancing our sample as far as possible in terms of size and geographical distribution, we entered the trade directory data for Whitehaven (Cumberland), Gateshead (Durham), Boston and Lincoln (Lincolnshire), Newark-on-Trent (Nottinghamshire), Kingston-upon-Hull (East Yorkshire) and Leeds (West Yorkshire).¹⁵ We made the calculations described above (based on each of the alternative assumptions) and then compared the total number of businesses estimated from the census to the total number of businesses recorded in the trade directories.¹⁶ The number of businesses recorded in the trade directories was much smaller, showing conclusively that the directories do not offer an exhaustive list of businesses in operation.

¹⁵ In the pdf of the census that is publicly available in the Chadwyck-Healey collection, data appear for only 34 towns. Most of these towns happen to be quite large and located in the north of England, viz: Chester, Macclesfield, Stockport, Carlisle, Whitehaven, Derby, Durham, Gateshead, South Shields, Sunderland, Blackburn, Bolton, Lancaster, Liverpool, Manchester and Salford, Oldham, Preston, Leicester, Boston, Lincoln, Newport, Newark-on-Trent, Nottingham, Newcastle upon Tyne, Tynemouth, Kendal, Kingston-upon-Hull, York, Bradford, Halifax, Huddersfield, Leeds, Sheffield and Wakefield. We began our work on the basis of these towns only and it is that which we report in this section, having matched the towns to contemporary trade directories as far as possible. We later discovered, by going back to the printed copy of the census, that data are provided for many other towns – but these were erroneously missed out of the pdf file that is publicly available from Chadwyck-Healey. To make our sample more complete, we later added “Greater Birmingham” (that is, Birmingham, Bromesgrove, Burton-on-Trent, Cheadle, Droitwich, Dudley, Evesham, Kidderminster, Leek, Litchfield, Newcastle-under-Lyne, Penkridge, Pensnall, Pershore, Stafford, Stoke-on-Trent, Stone, Stourbridge, Tamworth, Tenbury, Upton-on-Severn, Uttoxeter, Walsall, West Bromwich, Wolverhampton, Worcester).

¹⁶ A small number of occupational terms used in the census were not used in the trade directory. For example, no business is listed as a “Fustian manufacturer”; since fustian was a type of fine cotton cloth, those businesses were presumably listed as “Cotton manufacturer”. The same is true of “Thread manufacturer” and “Calico and cotton printer”. We therefore aggregated workers in those industries (as reported in the 1851 census) with cotton manufacturers and calculated one multiplier for all branches of the cotton industry than we applied to each of its components (cotton, fustian, thread and printing). For “Weaver (material not stated)” we took the multiplier to be the average of cotton, flax and woolen manufacturers. For “Skinner” we took the multiplier to be the average of other occupations in the sub-class (which were all very similar); and the same for “Fuller”.

But recall that we are not actually trying to find the *number* of businesses. All we are trying to discover is the *distribution* of businesses (and, from there, the distribution of individuals' occupations). Were the distributions of businesses across occupations the same in the census and the trade directories? Yes. How can we summarize their similarity in some type of descriptive statistic? Calculate the percentage of total businesses constituted by each occupation in both the census and the trade directory. That is, work out what percentage of businesses were bakeries, tailors, taverns, and so on. Now regress the trade directory distribution on the census distribution. What should you expect to find if the trade directory is a random sample of businesses in a particular town? Then a one per cent larger share accruing to a particular occupation in the census will be reflected by a one per cent larger share accruing to that occupation in the trade directory (i.e. the coefficient on the census data will be unity). So if bakeries and taverns comprised five per cent and ten per cent respectively of the population of businesses in a town, according to the census, then they should similarly comprise five per cent and ten per cent respectively of the businesses recorded in the trade directory.

Of course, to the extent that there is measurement error in the estimated occupational structure derived from the trade directory, the estimated coefficient in the regression will be biased downwards, for standard econometric reasons. Hence we expect to observe estimated coefficients that are less than unity but hopefully not statistically significantly different from it. If the overall distributions are quite similar then the fit of the regression (the r-squared) will also be high. Note that some of the trade directories that we matched against the 1851 census were compiled several years after the census; we chose them simply because they were the closest years available. Such temporal mismatch would be expected to induce more measurement error and bias the results towards rejecting the hypothesis that the trade directories and the census exhibit the same occupational distribution. Note further that this need not generally be a problem with using trade directories. We are constrained here to find trade directories as close as possible to 1851 because we are undertaking a direct test against the census. If we were given a free choice of year, and were simply trying to assemble a set of trade directories that gave a good coverage, then there would be less temporal mismatch. We would simply construct an occupational distribution for whichever year had the best trade directory coverage (such as 1770 or 1784, when Bailey's first national directory appeared).

We undertook the regression exercise for our sample of towns and found that the distributions of the census and trade directories were fairly similar for each town, and the coefficient on the census was not significantly different from unity. We report these regressions in table 4 below. These results suggest that the 1851 census can generate an occupational distribution of businesses that mirrors that found in trade directories – both at the local and national levels. The results also imply that it is safe to work in the other direction – i.e., infer the occupational distribution that we would observe in the census from contemporary trade directories.

Table 4. Regressing trade directory occupational shares on those of the census, c. 1851.

	<i>Coefficient</i>	<i>95% confidence interval</i>	<i>r²</i>	<i>N</i>
Greater Birmingham	0.86	0.75 – 0.97	0.71	97
Boston	0.95	0.79 – 1.10	0.70	64
Gateshead	0.91	0.75 – 1.08	0.66	61

Kingston upon Hull	0.85	0.70 – 1.00	0.65	70
Leeds	0.92	0.82 – 1.03	0.79	82
Lincoln	1.01	0.86 – 1.15	0.73	72
Newark	1.00	0.83 – 1.16	0.71	60
Whitehaven	0.93	0.75 – 1.12	0.57	76
Pooled sample	0.99	0.90 – 1.09	0.78	119

Notes. We exclude all occupations for which there are zero workers and all occupations for which this is no multiplier available from the table of employees per business. We aggregated “Builders” with “Mason (pavior)” and “Bricklayer”; we excluded “Merchants” because the multiplier in the table of employees per business is based on only three observations in the entire country; and we excluded the top five and bottom five occupations (in terms of their distance from the occupational share reported in the census) in each town. Our rationale for the last step was that there were a small number of very large outliers that were drastically and randomly skewing the results, and most of these outliers were obviously problematic. For example, “Coal miners” seem to be massively underreported in the trade directories, compared to the census. But this is easily understood when we see that the table of employees per business reports an average of 49 miners per coal mine, which must surely be a drastic underestimate. In general, it was more or less the same 10 occupations that were problematic in each of the towns (notably, “Straw hat and bonnet maker”, “Woollen cloth manufacture”, “Flax, linen manufacture”, “Coal merchant, dealer”, “Shopkeeper (branch undefined)” and “Hosier, haberdasher”). The number of observations differs for each regression simply because some towns have more occupations than others.

We feel that these results are satisfactory and act as a “proof of principle”: occupational structure can be inferred from trade directories. However, the approach outlined above is not an optimal solution for a number of reasons. First, the table of employees per business in the 1851 census is truncated: the largest size bracket in the table is for those employing “350 or more”. Thus those establishments employing 350 are lumped in with those employing several thousand. Since some industries, such as cotton, are likely to have had systematically larger establishments than other industries, this could well introduce a bias into the results. Second, some industries provided very few returns; for example, only three merchants in the whole of Great Britain reported the number of people that they employed. So the figure for employment by merchants is much less reliable than the figures for industries in which thousands of returns were received.

Third, relying on the employment table in the census throws away important information. We have fitted the trade directory data to the census data using the employment table and shown that this gives coherent results. But is this the best that can be done? No. The employment table is very imperfect. And we know exactly how imperfect it must be. If we divide the census data by the trade directory data then we can create our own employment table. This table is exact, in the sense that it matches the two data series perfectly, by construction. Since this is the best that we can hope to do, it is logical to use this inferred table of employment in place of the one found in the census, even though the census table performs adequately. Fourth, and perhaps most importantly, the census table of employees per business does not cover all the occupations recorded in the census. In fact, it covers only around 240 of them, out of 369 in total. Some individual occupations are retained (such as “Iron founder); but many of them are aggregated into broader categories (such as “Other iron workers”). This is hugely disappointing because we would like to study in detail the changing pattern of industrial production. If most of the individual occupations are aggregated then the coarseness of the resulting occupational structure will preclude us from being able to offer a precise description of England’s industrialization. The trade directories record businesses in

several thousand distinct occupations, so if we had an employment table that covered all the 369 occupations reported at the town level in the 1851 census then we could aggregate the trade directory data in such a way as to produce a national occupational census for earlier years that was exactly analogous to the census tables of 1851. Moreover, this set of 369 occupations was designed by the Registrar General in 1851 to encompass all possible occupations in the economy, so it is coherent and complete. For these reasons, we believe that the constructed table of employees per business offers a superior solution to using that found in the 1851 census.

An obvious problem with using the trade directories predating 1851 is that there is no table of employees per business before that produced in the 1851 census. One must be created, and two obvious strategies commend themselves. First, this could be done from contemporary historical sources. Take contemporary accounts of cotton factories, ironworks, coal mines, bakeries and so on; note, on average, how many employees there were per business. This could be done for each date; average employment per business (occupation) could be allowed to change over time. If the historical record on business size were sufficiently rich, then this would be the most precise approach. Second, we could impose on earlier years the employees per business table from 1851. This has the disadvantage that it is temporally removed, but the advantage that it is accurately observed; we are trading off two types of error.

Suppose that we construct a table of employees per business by dividing the census population by the number of businesses in the trade directory. This actually conflates two effects. First, there are a certain number of employees per business. Second, there is under-registration of businesses. Suppose that there were actually two employees per baker but only half of the bakers appeared in the trade directory. Then we will infer erroneously that there were four employees per baker. Is this a problem? Not necessarily, for the following reason.

We would use the table of employees per business for 1851 to reflate our register of businesses in (say) 1770. This generates a synthetic occupational census for 1770. The only thing that is important for this method to be valid is that the weights reflected in the table are stable between 1770 and 1851. This will occur most obviously if all the components are stable (there are always two employees per baker and bakers always appear in the trade directory with a 50 per cent probability). But the requirements for our table to be functional are actually much weaker than this. For example, suppose that all businesses have a 50 per cent probability of appearing in the trade directory in 1851, but only a 25 per cent probability in 1770. This would not bias our results because the estimated employment in all occupations would be falling proportionately to one another – so our estimate of the distribution of workers across occupations would be unaffected. Suppose that establishment size was rising in all occupations: there were two bakers per bakery in 1770 but four bakers per bakery in 1851. This would not generate any bias as long as establishment size was rising at the same rate in all occupations.

By contrast, it is highly likely that differential changes across occupations in the frequency of business registration in the trade directory, or differential changes in establishment size, would reduce the accuracy of our estimated distribution of the working population in 1770. That is, unless changes in frequency and changes in establishment size happened to offset each other. We have no way of knowing whether there were differential changes in the table of employees per business between 1770 and

1851 without constructing a table of employees per business in 1770, relying on contemporary sources. However, if we opted to rely solely on the 1851 table then we could at least consider the likely direction of any such changes in business size (such as the increase in the size of cotton mills) and ask to what extent – and in what direction – our estimated occupational structure might be biased. This type of sensitivity analysis can help us to put plausible bounds on the scale of the problem.

4. Conclusions. Trade directories are numerous and easily accessible for the period 1770 to 1856. But, surprisingly, they have not previously been exploited in a systematic way. Although the quality is variable, the producers of trade directories employed several innovative and wily techniques to elicit complete and accurate information. For example, they used crowdsourcing and local booksellers to collect information, paying the latter in free offprints (which would only have a high retail value if the directory were of good quality). The trade directories constitute a potentially valuable untapped source of information on occupational structure at a crucial stage of Britain’s industrialization. Importantly, trade directories do not suffer from the gender, religious, lifestyle and lifecycle biases inherent in other sources, such as baptism records.

We have shown that trade directories can be used to generate an employment distribution across occupations that mirrors the true distribution, as revealed by the census. We tested this contention for the year 1851 – the first year for which we have a detailed occupational census. Regression analysis shows that a one percent increase in the share of an occupation in the trade directory is, on average, matched by a one percent increase in the share in the census (controlling for the number of employees per business). There are alternative procedures for controlling for the number of employees per business, such as using contemporary sources or the data from 1851; each approach has its advantages and disadvantages.

A worthwhile next step would be to undertake a large-scale exercise for an earlier benchmark year – such as 1784 or the mid-1790s, when we have nationwide trade directories – to gauge the results of a rigorous and complete analysis. It is to be hoped that such an attempt will be completed in the near future.

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Appendix 1. Town-level occupational breakdown of the 1851 census.

ID	Class	Sub-class	Occupation
1	1	1	Post Office
2	1	1	Inland Revenue
3	1	1	Customs Service
4	1	1	Other Government officers
5	1	2	Police
6	1	2	Union relieving officer
7	1	2	Officer of local board
8	1	2	County, local, -officer (not otherwise distinguished)
9	1	3	East India Service
10	2	1	Army officer
11	2	1	Army half-pay officer
12	2	1	Soldier
13	2	1	Chelsea pensioner
14	2	2	Navy officer
15	2	2	Navy half-pay officer
16	2	2	Seaman, R. N.
17	2	2	Greenwich pensioner
18	2	2	Marine
19	2	2	Others engaged in defence
20	3	1	Clergyman
21	3	1	Protestant minister (not otherwise described)
22	3	1	Priest of other religious bodies
23	3	2	Barrister, advocate, special pleader, conveyancer
24	3	2	Solicitor, attorney, writer to signet
25	3	2	Other lawyers
26	3	3	Physician
27	3	3	Surgeon, apothecary
28	3	3	Other medical men
29	3	4	Parish clerk, clerk to church
30	3	4	Other Union, district and parish officer
31	3	5	Law clerk
32	3	5	Law stationer
33	3	6	Druggist
34	3	6	Others dealing in drugs
35	4	1	Author
36	4	1	Editor, writer
37	4	1	Others engaged in literature
38	4	2	Painter (artist)
39	4	2	Architect
40	4	2	Others engaged in the fine arts
41	4	3	Scientific person, observatory and museum keeper
42	4	4	Music-master
43	4	4	Schoolmaster, schoolmistress
44	4	4	Governess
45	4	4	Other teachers
46	5	1	Wife (of no specified occupation)
47	5	2	Widow (of no specified occupation)
48	5	3	Son, grandson, brother, nephew (not otherwise returned)
49	5	3	Daughter, granddaughter, sister, niece (not otherwise returned)
50	5	4	Scholar – under tuition at home
51	5	4	Scholar – under tuition at school or college
52	6	1	Innkeeper
53	6	1	Innkeeper's wife
54	6	1	Lodging-house keeper
55	6	1	Officer of charitable institution
56	6	1	Others – boarding and lodging
57	6	2	Domestic servant (general)
58	6	2	Housekeeper
59	6	2	Cook

60	6	2	Housemaid
61	6	2	Nurse
62	6	2	Inn servant
63	6	2	Nurse at hospital, etc.
64	6	2	Midwife
65	6	2	Charwoman
66	6	2	Coachman
67	6	2	Groom
68	6	2	Gardener (servant)
69	6	3	Hairdresser, wig-maker
70	6	3	Hatter
71	6	3	Straw hat, bonnet, -maker
72	6	3	Furrier
73	6	3	Tailor
74	6	3	Cap, -maker, dealer
75	6	3	Milliner, dressmaker
76	6	3	Shirtmaker, seamster
77	6	3	Shawl manufacturer
78	6	3	Staymaker
79	6	3	Hosier, haberdasher
80	6	3	Hose (stocking) manufacture
81	6	3	Laundry-keeper, mangler
82	6	3	Rag, -gatherer, dealer
83	6	3	Glover (material not stated)
84	6	3	Shoemaker, bootmaker
85	6	3	Shoemaker's wife
86	6	3	Patten, clog, -maker
87	6	3	Umbrella, parasol, stick, -maker
88	6	3	Others providing dress
89	7	1	House proprietor
90	7	1	Merchant
91	7	1	Banker
92	7	1	Ship-agent
93	7	1	Broker
94	7	1	Agent, factor
95	7	1	Salesman, saleswoman
96	7	1	Auctioneer, appraiser, valuer
97	7	1	Accountant
98	7	1	Commercial clerk
99	7	1	Commercial traveller
100	7	1	Pawnbroker
101	7	1	Shopkeeper (branch undefined)
102	7	1	Shopkeeper's wife
103	7	1	Hawker, pedlar
104	7	1	Other general merchants, dealers, agents
105	8	1	Railway engine, -driver, stoker
106	8	1	Others engaged in railway traffic
107	8	2	Toll collector
108	8	2	Coach and cab owner
109	8	2	Livery-stable keeper
110	8	2	Coachman (not domestic servant)
111	8	2	Carman, Carrier, carter, drayman
112	8	2	Omnibus, -owner, conductor
113	8	2	Others engaged in road conveyance
114	8	3	Canal and inland navigation service
115	8	3	Boat and bargeman
116	8	3	Others connected with inland navigation
117	8	4	Shipowner
118	8	4	Seaman (merchant service)
119	8	4	Pilot
120	8	4	Others connected with sea navigation
121	8	5	Warehouseman
122	8	5	Others connected with storage
123	8	6	Messenger, porter (not Government), errand-boy
124	8	6	Others employed about messages

125	9	1	Land proprietor
126	9	1	Farmer
127	9	1	Grazier
128	9	1	Farmer's, grazier's wife
129	9	1	Farmer's, grazier's son, grandson, brother, nephew
130	9	1	Farmer's, grazier's daughter, granddaughter, sister, niece
131	9	1	Farm bailiff
132	9	1	Agricultural labourer (outdoor)
133	9	1	Shepherd
134	9	1	Farm servant (indoor)
135	9	1	Others connected with agriculture
136	9	2	Woodman
137	9	2	Others connected with arboriculture
138	9	3	Gardener
139	9	3	Nurseryman
140	9	3	Others connected with horticulture
141	10	1	Horse-dealer
142	10	1	Groom, horse-keeper, jockey
143	10	1	Farrier, veterinary surgeon
144	10	1	Cattle, sheep, dealer, salesman
145	10	1	Drover
146	10	1	Gamekeeper
147	10	1	Vermin-destroyer
148	10	1	Fisherman
149	10	1	Others engaged about animals
150	11	1	Bookseller, publisher
151	11	1	Bookbinder
152	11	1	Printer
153	11	1	Others engaged about publications
154	11	2	Actor
155	11	2	Others engaged about theatres
156	11	3	Musician (not teacher)
157	11	3	Musical instrument, -maker, dealer
158	11	3	Others connected with music
159	11	4	Engraver
160	11	4	Others employed about pictures and engravings
161	11	4	Others engaged about figures and carving
162	11	5	Artificial flower maker
163	11	6	Toy, -maker, dealer
164	11	6	Persons connected with shows, games and sports
165	11	7	Civil engineer
166	11	7	Pattern designer
167	11	7	Other designers and draughtsmen
168	11	8	Medallist and medal-maker
169	11	9	Watchmaker, clockmaker
170	11	9	Philosophical instrument maker
171	11	10	Gunsmith
172	11	10	Others engaged in manufacture of arms
173	11	11	Engine and machine maker
174	11	11	Tool-maker
175	11	11	Others dealing in tools and machines
176	11	12	Coachmaker
177	11	12	Others connected with carriage making
178	11	13	Saddler, harness-maker
179	11	13	Whip-maker
180	11	13	Other harness-makers
181	11	14	Shipwright, shipbuilder
182	11	14	Boat, barge, -builder
183	11	14	Others engaged in fitting ships
184	11	15	Surveyor
185	11	15	Builder
186	11	15	Carpenter, joiner
187	11	15	Bricklayer
188	11	15	Mason, pavior
189	11	15	Slater

190	11	15	Plasterer
191	11	15	Painter, plumber, glazier
192	11	15	Others engaged in house construction
193	11	16	Wheelwright
194	11	16	Millwright
195	11	16	Other implement makers
196	11	17	Dyer, scourer, calenderer
197	11	17	Others engaged in manufacture of chemicals
198	12	1	Cowkeeper, milkseller
199	12	1	Cheesemonger
200	12	1	Butcher, meat salesman
201	12	1	Butcher's wife
202	12	1	Provision curer
203	12	1	Poulterer, gamedealer
204	12	1	Fishmonger, dealer, seller
205	12	1	Others dealing in animal food
206	12	2	Soap-boiler
207	12	2	Tallow-chandler
208	12	2	Comb-maker (for manufactures)
209	12	2	Others dealing in grease and bones
210	12	3	Fellmonger
211	12	3	Skinner
212	12	3	Currier
213	12	3	Tanner
214	12	3	Other workers in leather
215	12	4	Feather, -dresser, dealer
216	12	5	Hair, bristle, -manufacture
217	12	5	Brush, broom, -maker
218	12	5	Other workers, dealers in hair
219	12	6	Woolstapler
220	12	6	Knitter
221	12	6	Woollen cloth manufacturer
222	12	6	Fuller
223	12	6	Worsted manufacturer
224	12	6	Stuff manufacturer
225	12	6	Clothier
226	12	6	Woollen draper
227	12	6	Carpet, rug, -manufacture
228	12	6	Other workers, dealers in wool
229	12	7	Silk manufacture
230	12	7	Silkmercer
231	12	7	Ribbon manufacture
232	12	7	Fancy goods manufacture
233	12	7	Embroiderer
234	12	7	Other workers dealing in silk
235	13	1	Greengrocer
236	13	1	Corn merchant
237	13	1	Miller
238	13	1	Flour-dealer
239	13	1	Baker
240	13	1	Confectioner
241	13	1	Others dealing in vegetable food
242	13	2	Maltster
243	13	2	Brewer
244	13	2	Licensed victualler, beershopkeeper
245	13	2	Licensed victualler, beershopkeeper's wife
246	13	2	Wine and spirit merchant
247	13	2	Sugar-refiner
248	13	2	Grocer
249	13	2	Tobacconist
250	13	2	Others dealing in drinks, stimulants
251	13	3	Oil and colourman
252	13	3	French-polisher
253	13	3	Other workers, dealers in oils, gums & c.
254	13	4	Timber merchant

255	13	4	Other dealers, workers in timber
256	13	5	Cork-cutter
257	13	5	Others dealing in bark
258	13	6	Sawyer
259	13	6	Lath-maker
260	13	6	Other wood workers
261	13	7	Cabinet-maker, upholsterer
262	13	7	Turner
263	13	7	Chair-maker
264	13	7	Box-maker
265	13	7	Others dealing in wood furniture
266	13	8	Cooper
267	13	8	Other makers of wood utensils
268	13	9	Frame-maker
269	13	9	Block and print cutter
270	13	9	Other wood tool makers
271	13	10	Basket-maker
272	13	10	Thatcher
273	13	10	Straw plait manufacture
274	13	10	Other workers in cane, rush, straw
275	13	11	Ropemaker
276	13	11	Sailcloth manufacture
277	13	11	Others working in hemp
278	13	12	Flax, linen, -manufacturer
279	13	12	Thread manufacture
280	13	12	Weaver (material not stated)
281	13	12	Draper
282	13	12	Lace manufacture
283	13	12	Cotton manufacture
284	13	12	Lint manufacture
285	13	12	Packer and presser (cotton)
286	13	12	Fustian manufacture
287	13	12	Muslin embroiderer
288	13	12	Calico, cotton, -printer
289	13	12	Calico, cotton, -dyer
290	13	12	Other workers, dealers in flax, cotton
291	13	13	Paper manufacture
292	13	13	Stationer
293	13	13	Paper-stainer
294	13	13	Paper-hanger
295	13	13	Other paper workers, dealers
296	14	1	Coal-miner
297	14	1	Coal, -merchant, dealer
298	14	1	Coal heaver or labourer
299	14	1	Chimney-sweeper
300	14	1	Gasworks service
301	14	1	Other dealers, workers in coal
302	14	2	Stone-quarrier
303	14	2	Slate-quarrier
304	14	2	Limestone, -quarrier, burner
305	14	2	Marble mason
306	14	2	Brick, -maker, dealer
307	14	2	Road labourer
308	14	2	Railway labourer
309	14	2	Other workers in stone, lime, clay
310	14	3	Earthenware manufacture
311	14	3	Earthenware and glass dealer
312	14	3	Tobacco-pipe maker
313	14	4	Glass manufacture
314	14	4	Other workers in glass
315	14	5	Salt, -agent, merchant, dealer
316	14	6	Water, -carrier, dealer
317	14	7	Workers, dealers in precious stones
318	14	8	Goldsmith, silversmith
319	14	8	Plater

320	14	8	Carver, gilder
321	14	8	Other workers in gold and silver
322	14	9	Copper-miner
323	14	9	Copper manufacture
324	14	9	Coppersmith
325	14	9	Other workers, dealers in copper
326	14	10	Tin-miner
327	14	10	Tinman, tin-worker, tinker
328	14	10	Other workers, dealers in tin
329	14	11	Zinc manufacture
330	14	11	Other workers, dealers in zinc
331	14	12	Lead-miner
332	14	12	Lead manufacture
333	14	12	Other workers, dealers in lead
334	14	13	Brass, -manufacture, founder, moulder
335	14	13	Locksmith, bellhanger
336	14	13	Brazier
337	14	13	White metal manufacture
338	14	13	Pin manufacture
339	14	13	Button-maker (all branches)
340	14	13	Wire, -maker, drawer
341	14	13	Wire, -worker, weaver
342	14	13	Other workers, dealers in mixed metals
343	14	14	Iron-miner
344	14	14	Iron, manufacture, moulder, founder
345	14	14	Whitesmith
346	14	14	Blacksmith
347	14	14	Nail manufacture
348	14	14	Anchorsmith, chainsmith
349	14	14	Boiler-maker
350	14	14	Ironmonger
351	14	14	File-maker
352	14	14	Cutler
353	14	14	Needle manufacture
354	14	14	Grinder (branch undefined)
355	14	14	Other workers, dealers in iron, steel
356	15	1	Labourer (branch undefined)
357	15	2	Mechanic, manufacturer, shopman, shopwoman
358	15	3	Others of indefinite occupations
359	16	1	Gentleman, gentlewoman, independent
360	16	1	Annuitant
361	16	1	Others of independent means
362	17	1	Dependent on relatives (not classed elsewhere)
363	17	1	Almsperson
364	17	1	Pauper of no stated occupation
365	17	1	Lunatic of no stated occupation
366	17	1	Others supported by the community
367	17	2	Prisoner of no stated occupation
368	17	3	Vagrants in barn, tents, etc.
369	18	1	Persons of no stated occupations or conditions

*How fast, and how broad, was British industrialization? Evidence from a synthetic occupational census for 1801**

Liam Brunt[†] & Jan Erik Meidell[‡]

Abstract

Employing the procedure proposed by Brunt and Meidell (chapter 1), we take a stratified sample of 100 000 businesses from the *Universal British Directory* and use it to estimate local and national occupational structures in England and Wales in 1801. Classifying the 1801 occupations using the censal system of 1851 enables us to track changes in male and female employment. We find an increase in industrial employment similar to Crafts-Harley, and much faster than that implied by Kitson *et al.*. Industrialization was broad, consistent with Temin's findings on export growth.

Keywords: Census, structural change, industrialization.

JEL classifications: J21, N13, O14, Y10.

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0. Introduction. Recent characterizations of the British industrial revolution have played down the rate of economic growth, which is now widely agreed to have been slower than was suggested originally by Deane and Cole.¹ Instead, more emphasis has been placed on the role of structural change, especially the transfer of labor resources from agriculture to industry.² An obvious lacuna in this line of argument is that the available quantitative evidence on the rate or extent of structural change has been weak. The first census did not take place until 1801 and the occupation data that were collected in that year are worthless; households are categorized into three sectors (“Agriculture”, “Industry” or “Other”) and for most counties these sum to something like 50 per cent of the number of households, leaving us to wonder what the rest of the population were doing. Only with the census of 1841 do we get the first reliable estimates of occupational structure; but by this time the first stage of industrialization was almost complete and it is therefore not much help in measuring structural change. There have been previous efforts to quantify English social structure in the eighteenth century³; these have formed the basis of important quantitative research.⁴ But social structure is not exactly the same thing as occupational structure (even though the two are linked); and the quantification has been fairly broad brush and based on very imperfect sources. Recent research by the team at Cambridge led by Shaw-Taylor and Wrigley has used a variety of sources – particularly baptismal records and militia ballots – to address this issue and they seem to paint a very different picture to the one that we are used to, with much higher rates of industrialization by 1801.⁵ We discuss their research much more fully in later sections.

In this paper we bring to bear a large quantity of new data. In the late eighteenth century trade directories began to appear, which reported for each town the businesses that were in operation. Since incorporation was outlawed, virtually all businesses were either sole proprietorships or partnerships; it was therefore natural for the directories to list the names of each individual businessman or partner and this is a good guide to the total number of people who were actually in business. The *Universal British Directory* (hereafter *UBD*) appeared between 1793 and 1798 and was the most complete example of the genre, offering both a wide geographical coverage and a detailed register of local businesses.⁶ We take a stratified sample of towns and use this to construct estimates of both the national and regional structure of businesses, based on the entries for approximately 80 000 individuals operating 100 000 businesses. We then move from business structure to occupational structure using estimates of workers per business establishment. We test this method for 1851, using the census and contemporary trade directories, and show that it offers a reasonable level of accuracy. Since the trade directories essentially report only urban data, we supplement these data on industry and services with estimates of agricultural employment (based on the 400 farms surveyed by Arthur Young) and other primary sector occupations (based on various government enquiries).⁷ We also adduce data on the government sector, which is covered only erratically in trade directories but which turns out to be a crucial consideration. Finally, we estimate the size of the non-working population. The 1801 census provides hard evidence on total

¹ Deane and Cole, *British economic growth*; Crafts and Harley, “Output growth”; Antràs and Voth, “Factor prices”.

² Crafts, *British economic growth*.

³ Lindert and Williamson, “Revising”.

⁴ Crafts, *British economic growth*.

⁵ Kitson et al., “Creation of a ‘census’”; Shaw-Taylor et al., “Occupational structure”; Wrigley, “PST system”.

⁶ Barfoot and Wilkes, *Universal British directory*.

⁷ Young, *Six weeks’ tour*; *Six months’ tour*; *Farmer’s tour*.

population size, so we take 1801 as our benchmark date. Combining all these sources gives us a fairly complete picture of the English and Welsh workforce in *c.* 1801, near the beginning of industrialization. Hence we refer to it as a ‘synthetic occupational census’.

Since our goal is to track temporal changes in occupational structure, we compare our results from 1801 to the census of 1851, near the end of the first industrial revolution. We ensure that the two cross sections are fully comparable by classifying all our workers from 1801 according to the occupational classification scheme used in the 1851 census, which is generally accepted as the most complete investigation of occupational structure.⁸

In the next section we consider the problem of matching data from the 1851 census with data from contemporary trade directories. In section 2 we describe our data and sampling procedure for 1801 in more detail. In Section 3 we consider which occupations will be systematically missing from the *UBD*. Section 4 addresses the issue of employment on farms and section 5 presents the available data on other primary sector employment. Section 6 adduces data on the civilian government establishment; section 7 adduces data on the military establishment. Section 8 examines data on the cotton industry. Section 9 charts the change in national occupational structure from *c.* 1801 to 1851 and offers a comparison with alternative estimates. Section 10 analyses the data at a more disaggregated level. Section 11 concludes. Appendix 1 discusses the problem of estimating the urban population in 1801, and hence how to construct a properly stratified sample. Appendix 2 outlines the occupational breakdown used in the 1851 census, and here also.

1. The trade directory approach. The first worthwhile English occupational census was taken in 1851. Therefore, in order to track changes in occupational structure up to 1851, we need to construct a synthetic occupational census for some earlier date. Brunt and Meidell suggest that this could be done using trade directories. They show that local trade directories from around 1851 map to the local census returns in that year. With a sufficiently extensive sample of trade directories for some earlier year, suitably weighted, it should be possible to construct national estimates of occupational structure. The information structure of the problem is sketched in table 1 below.

Table 1. Data sources available to track occupational change.

1801	1851
?	Occupational census
Trade directory	Trade directory

The key element in this process is a table of employees per business: this allows us to move from trade directories to the census, and vice versa. Using trade directories, we start by compiling data on how many businesses there were of each type (i.e. the number of businesses in each occupation). We then multiply those businesses by the average number of employees in each type of business (i.e. the employees per business in each occupation). Brunt and Meidell were able to use the table of employees per business that was reported in the 1851 census. They showed that applying this weighting scheme to the trade directory

⁸ Registrar General, *Census*, part 2, vol.1, cxxii-cxxvii. There are a total of 1 090 individual occupations classified into 17 classes and 90 sub-classes. Town-level census data are reported at a slightly more aggregated level of 369 occupations; see appendix 2 of this paper for a complete list. We adopt the town-level format, for reasons that we explain in the text.

business data generated an estimated occupational employment structure that was close to that revealed in the 1851 census.

However, a table of employees per business is not readily available for earlier years. Brunt and Meidell consider various solutions to obtaining or creating the required table – such as constructing a table from contemporary sources, using the table from the 1851 census, or constructing a table for 1851 by combining the trade directories and census data. (That is, take the number of people in each occupation in a town – as reported in the 1851 census – and divide it by the number of businesses reported in the local trade directory.) Constructing a table for 1851 has the advantage that it makes best use of all the available information. In reconciling the trade directories and the census, it controls both for the fact that each business had multiple employees and for the fact that there was some under-registration of businesses in the trade directories. By contrast, the table of employees per business reported in the 1851 census controls for only the first effect. Creating our own table of employees per business – from the census and the trade directories – also has the advantage of generating a ratio of employees per business for every occupation; by contrast, there are some occupations missing from the table provided in the 1851 census. Given that it would be difficult to find contemporary estimates of the number of employees per business in 1801 for all 369 occupations, we will rely instead on the table constructed for 1851. This may, of course, generate some biases; we consider this issue in considerable detail later in the paper.

Let us now turn to our first and most difficult task, constructing a register of businesses in 1801.

2. Data sources and sampling procedures for 1801. Our data on the business structure of the private, non-agricultural sector are drawn from the *UBD*, which was published in nine volumes between 1793 and 1798. The *UBD* was a combined Yellow Pages and White Pages of its time. It offered very extensive lists of tradesmen in each town, as well as separate sections for gentry, clergy, lawyers, doctors, bankers, the town corporation (i.e. town management), substantial outposts of government (such as Royal dockyards or the Customs Service) and transport (masters of coaches, barges and locally-based ships). In the case of London, the section on tradesmen alone covers 260 pages and amounts to around 34 000 entries; in the case of Manchester, the section on tradesmen covers 72 pages and amounts to around 8 000 entries; and in the case of Birmingham, the section on tradesmen covers 32 pages and amounts to around 3 200 entries. Smaller towns obviously required fewer pages, and the smallest as few as one page or a half-page. We extracted the complete list of professional and business entries for all the towns in our sample, except Birmingham and Manchester (where we took a 25 per cent sample) and London (where we took a five per cent sample, entering every twentieth page). We cannot know to what extent the *UBD* offers an exhaustive list of tradesmen because we have no independent, exhaustive source to which we can compare it. However, it should be noted that the *UBD* records thousands of businessmen who operated in very humble trades – bakers, grocers, haberdashers, bricklayers, shoemakers, hucksters and so on and so forth. So it does not appear that the authors systematically excluded the less glamorous occupations.⁹ The *UBD* additionally fulfilled some of the

⁹ One strange omission is that of “Beer shopkeeper” in London – where none at all are recorded, even though they are widely reported in other towns. Perhaps beer shops were so common in London that it was not necessary for them to advertise in the directory. We know from licensing data that there were 4 184 beer shops in London in 1821 – see British Government, “Report from the select Committee on the sale of beer”, 130.

functions of a tour guide, describing local highlights and giving a potted history of each town; these could be very extensive (for example, 35 pages in the case of Oxford) but were typically very short (just a paragraph or two).

Each entry in the *UBD* typically recorded the name of the individual (or partnership) and their line of business; in some towns it recorded also the address. It is noteworthy that many individuals and partnerships operated in several lines of business, sometimes up to six, and these were dutifully reported in the *UBD*. Often these occupations were related to one another, such as plumber and glazier (both of which used lead as a raw material); but sometimes the lines of business were quite unrelated (such as seedsman, tavern keeper and coffin maker). This raises the problem of multiple occupations, which is a continuing problem in census enumeration. The modern solution is to ask people to report only their main occupation.¹⁰ In earlier times, people were asked to report all their occupations, in order of importance, but they were categorized according to their first reported occupation only.¹¹ An obvious concern is that some occupations might be reported systematically second or third and therefore be excluded systematically from the occupational returns. For example, if waste collectors were typically also carters then they might decide to record themselves as “Carter and waste collector” simply because the first occupation was more socially acceptable than the second. We would then end up with too few waste collectors reported in the occupational census. The census office was well aware of this problem and suggested that further study of the manuscript returns should be undertaken to examine this problem. We found no reference to any subsequent research but undertook some ourselves, as follows.

We recorded all the occupations for each individual and gave them equal weight (i.e. we effectively counted a person multiple times according to the number of occupations that he or she reported). We then calculated the national occupational structure and expressed each occupation as a percentage of total national employment. We then undertook the same exercise using only the first reported occupation for each individual. Purely as a descriptive statistic, we then regressed one set of occupational shares on the other set. The coefficient and r-squared were both 0.99, suggesting that there was no significant difference whatsoever between the two measures. Henceforth we worked with the dataset based on the first reported occupation only, in order to maintain consistency with later censuses.

As well as recording all the lines of business for each entry, we also noted – wherever possible – the number of people involved in a partnership. So we would note that an entry for “Brunt and Meidell” referred to two people; and we would note that an entry such as “Brunt, Meidell and Co.” referred to at least three people. Each of these individuals would then be recorded separately in the occupation list. However, in this paper, we are going to multiply each business by an employment factor per business (based on the data from 1851) to generate an estimate of employment in each occupation in 1801; therefore, in this paper we work with business entries and do not enter partnerships multiple times (even though we recorded that they comprised multiple partners).

Although one might imagine that the number was rising over time – in line with population – this expectation seems to be false. In fact, we know that there was a gradual but persistent national decline between (at least) 1815 and 1822 – down from 49 540 to 48 61 (see British Government, “Excise. An account showing the number of ale, wine, and spirits licences”; and British Government, “Beer (3). An account of the number of licensed victuallers”, 7). So it seems likely that there were around 4 184 beer shops in London in 1801, as there were in 1821, and we adopt that figure. Compared to 800 in Liverpool, this seems reasonable.

¹⁰ Office of National Statistics, *Census 2001: definitions*, 23.

¹¹ British Government, *Census of Great Britain, 1851: Population Tables II*, vol. 1, lxxxii.

One way in which the *UBD* might be unrepresentative is in terms of gender balance: certainly, the vast majority of people listed are male and the only occupation with a significant number of women listed is “Lodging house keeper”. One could therefore argue that the occupational structure that we document is for males only. However, it seems plausible that those in charge of businesses were predominantly male, as the *UBD* implies. But they had many female employees. When we reflate the business data using the table of employees per business, we make no distinction between men and women. That is, if the 1851 census recorded all working women – as well as the working men – then the women appear implicitly in the table of employees per business, just as the men do. Thus there should be no gender bias in our results, unlike those based on other sources – such as baptismal records – which report only the occupation of the father.

The *UBD* covers around 1 600 towns and villages across England and Wales, although for many of the smaller towns it does not record details on the businesses that were in operation. Instead, it simply gives a general description of the place and perhaps details on coach connections and such like. We do not know why the details on businesses were reported for some small towns and not others; as far as we are aware, there is no systematic bias. Even if the *UBD* offered information on a representative sample of English and Welsh towns – or, indeed, the entire population of towns – it is not clear that it would be optimal to enter all the data because it would be extremely time consuming. As it is, the overall *UBD* sample is neither representative nor complete and therefore we need to draw carefully a representative sample and reflate it in such a way that we can estimate as accurately as possible the local and national distributions of businesses across activities. The precise way in which we drew our sample is described in exhaustive detail in appendix 1. The broad outline runs as follows.

We used Clark and Hosking and Bairoch *et al.* to compile a complete list of all the towns in England and Wales, together with their populations.¹² Clark and Hosking included a large number of very small towns in their list – for example, 82 towns of fewer than 500 people – which could be considered as villages under a stricter definition of “town”. The Clark and Hosking decision to classify a place as a town depended partly on population but also on factors such as whether it was a transport hub or had a post office. We allocated all the towns to 10 different size categories based on their populations; the largest category (more than 156 000 people) contained only one town (London); and the smallest category (0 to 612 people) contained 123 towns.

We then tabulated the number of towns in each size category in each of 45 counties (taking each Riding of Yorkshire as a separate county, London as a county, and North Wales and South Wales as counties).¹³ We selected one town from each of the ten size categories in each county (taking the first one in the alphabet for which data were reported) and entered the data on the businessmen and businesswomen of that town and their occupations. We then multiplied this town by the number of towns on its county-size category, so that it would be given its proper weight in the national total. In fact, we were not entirely happy with this procedure because the largest size categories have relatively few towns in total and sometimes

¹² Clark and Hosking, *Population*; Bairoch *et al.*, *Population*.

¹³ We wanted all counties to be of the same order of magnitude, in terms of population and area. Hence we grouped the 12 diminutive Welsh counties into North Wales and South Wales and split up Yorkshire into its three Ridings. This was more convenient for our data collection process and will probably be of more use to future researchers who want to use our data because it will help to avoid problems of heteroskedasticity.

these all fell in one or two counties; this would mean that our sampling procedure would discard most of them because we took only one town in each county-size category. For example, in the whole of England and Wales there are two towns in category 2 – Liverpool and Manchester – and they were both in Lancashire. It makes little sense to sample only one of these towns because they were both very important in the English economy and had rather different occupational structures to one another. We therefore decided to sample the entire population of towns (114 of them) having more than 4 500 inhabitants in 1811. Inhabitants of these towns constituted around 77 per cent of the total urban population. To this sample of large towns we added the reflatd sample of towns drawn from the smaller town-size categories. Our sample from the smaller towns covered around 23 per cent of the people living in such towns (i.e. around five per cent of the total urban population). Thus our complete sample (large and small towns combined) covers towns in which 82 per cent of the urban population lived. Overall, we are confident that our sample is balanced both geographically and in terms of town size; that is, our synthetic urban population mirrors the historical distribution of urban population across counties and across town sizes in 1811. For this reason, it should offer a good guide to the occupational structure of England and Wales in 1801, the date at which the occupational data were gathered.¹⁴

3. Occupations not covered by the *UBD*. The *UBD* covers the vast majority of census occupations. Occupations not satisfactorily covered are reported in table 3 below. They fall into six areas: housewives and children (8.9 million people in 1851, out of a total English and Welsh population of nearly 18 million); domestic servants (1.0 million people); the farming sector (1.5 million people); some other primary sector occupations; the government, civil and military (0.09 million people); assorted unemployed people, such as prisoners, lunatics and the long term sick (0.3 million people).

Table 3. Weak points of the occupational coverage of the *UBD*.

<i>Class</i>	<i>Sub-class</i>	<i>Occupation</i>
I. Persons engaged in the general or local government of the country	1	Members of the royal family
		Peers (not otherwise returned)
		Members of the House of Commons (not otherwise returned)
		Her Majesty's court and household
		Civil service (not in the Post Office or Revenue Department)
		Post Office
		Inland Revenue
		Customs
		Messengers and workmen employed by the government
		Artificers and laborers in the dockyards
II. Persons engaged in the defense of the country	3	East India service
	1	Army officer
Army half-pay officer		
Soldier		
Chelsea pensioner		
Militia		
2	Navy officer	
	Navy half-pay officer	
		Seaman, R. N.

¹⁴ Note that our occupational data refer to *c.* 1795 (from the *UBD*) and *c.* 1801 (from other sources). It is only our urban sampling frame that is based on the distribution of population in 1811, for reasons discussed in the appendix. Virtually all towns would have been larger in 1811 than they were in 1801; but our sample will be unrepresentative only to the extent that towns had grown differentially in the intervening 10 to 16 years. We feel that any error induced by such differential growth is likely to be small.

V. Persons engaged in the domestic offices, or duties of wives, mothers, mistresses of families, children relatives	1	Marine Greenwich pensioner Officer of naval hospital Wife (no specified occupation)
	2	Widow (no specified occupation)
	3	Son, grandson, brother, nephew (not otherwise returned) Daughter, grand-daughter, sister, niece
	4	Scholar – under tuition at home Scholar – under tuition at school or college
VI. Persons engaged in entertaining, clothing and performing personal offices for man	1	Innkeeper's wife
	2	Domestic servant (general) Coachman Groom Gardener Housekeeper Cook Housemaid Nurse Inn servant Nurse at hospitals, etc. Corn-cutter Park gate, lodge –keeper Charwoman Midwife
VII. Persons who buy or sell, keep, let, or lend, money, houses, or good of various kinds	3	Shoemaker's wife
IX. Persons possessing or working the land, and engaged in growing grain, fruits, grasses, animals, other products	1	Shopkeeper's wife
	1	Land proprietor Farmer Grazier Farmer's, grazier's wife Farmer's, grazier's son, grandson, brother, nephew Farmer's, grazier's daughter, grand-daughter, sister, niece Farm bailiff Agricultural labourer (outdoor) Shepherd Farm servant (indoor) Land surveyor Land, estate, - agent Officer of agricultural society Agricultural student Hop-grower Grape-grower Willow, -grower, cutter, dealer Teazle, -grower, merchant Agricultural implement proprietor Drainage service Colonial, -planter, farmer
	2	Tacksman Woodman Wood, -keeper, bailiff Park, wood, -labourer, cutter Rod, -grower, dealer
XII. Persons working and dealing in animal matters	1	Butcher's wife
XIII. Persons working and dealing in matter derived from the vegetable kingdom	2	Licensed victualler, beer-shop-keeper's wife
XV. Labourers and others – branch of labour undefined	1	Labourer (branch undefined)
	2	Traveller (tramp)
XVII. Persons supported by the community, and of no specified occupation	1	Dependent on relatives
	2	Almsperson Pauper of no stated occupation Lunatic of no stated occupation Prisoners of no stated occupation Others of criminal class
	3	Vagrants in barns, tents, etc. Persons of no stated occupations or conditions, and persons not

The proportion of non-working categories may seem a high but, in fact, is comparable to modern economies, where the working population constitutes only around 50 percent of the total population. Hence the recurring modern debate about whether or not the domestic sector should be incorporated into the national income accounts: as it stands, the activity of most people is systematically excluded. We do not enter into that debate here; we simply attempt to provide some occupational data that are consistent over time and are based, as far as possible, on modern standards of national accounting. We adopted a variety of procedures to estimate, as best we could, the sectors not adequately covered in the *UBD*. We devote several sections below to estimating the agricultural workforce, other primary sector workers, and the government establishment in 1801. In this section we consider the other occupations.

There is really very little that we can do to quantify the number of housewives, children and so on in 1801 because they are not systematically recorded in any sources. Even if we used the Wrigley and Schofield data on population structure – which might enable us to estimate the number of children or widows, for example – then we would still have no way of splitting up these individuals into their appropriate categories. For example, we could not estimate the number of “Widows (no stated occupation)” because we cannot know how many widows are already included in the other occupations (which do not explicitly mention whether or not the female workers are widows). Since we are mainly concerned with the working population – and housewives and children would mostly be counted in the non-working population – the failure to quantify these occupations with the same level of accuracy as the other occupations is not as troubling as it might be. But we freely admit that the data that we report in this paper may not be especially informative for a study of the household sector of the economy.

Females are disproportionately under-reported. There are 33 occupations in the census that comprised only female participants. Some of these occupations are quantitatively unimportant (such as two professional “Artists’ models” in 1851); a few of the occupations we would expect be reported in the *UBD* (such as “Bonnet maker” or “Gun-wadding maker”). Most of the occupations are not in paid employment, such as “Wife (of no specified occupation)”. Given our economic focus – as opposed to a domestic or social focus – the most troubling categories are wives who were active in the commercial sector but who would not be reported independently in the *UBD*, such as “Butcher’s wife” or “Innkeeper’s wife”.

The best that we can do with respect to unreported occupations is to assume that – relatively – the quantitative importance of each of them was the same in 1801 as it was in 1851. For non-working occupations, most notably classes V and XVII, we assume that they comprised the same percentage of the total population in 1801 as in 1851. We make the same assumption for domestic servants. We assume that the distribution across towns and counties was also the same as in 1851. For employed wives (“Innkeeper’s wife”, etc.), we assume that they were as numerous – relative to husbands – in 1801 as in 1851 (so “Innkeepers’ wives” totaled 60 per cent of the number of “Innkeepers”, et cetera). Similarly, we assume that “Inn servants” bore the same proportion to innkeepers in 1801 as in 1851 (208 per cent). For a small number of (minor) occupations, there was either no entry in the *UBD* or it seemed likely that the occupation was drastically underrepresented (for example, because it was particularly geographically-specific and our sampling frame did not happen to have sampled a town from that locality). In such cases, we simply assumed that the occupation was the same percentage

of the population as in 1851. Obviously, this biases our results towards finding no change in the level of industrialization between 1801 and 1851. We believe that any such bias is quantitatively small. The estimation rule employed for each individual occupation is noted in appendix 2, table A6, column R.

4. The farm sector. The *UBD* contains essentially no information on the farm sector. This is not surprising because it records manufacturers, traders and service-providers based in conurbations, whereas most farmers and farm workers were located in the countryside. For many historical questions – such as the speed or character of industrialization – it is really the urban occupational structure that is key and therefore the *UBD* is sufficient. However, our goal is to construct an occupational census for England in 1801 that is as complete as possible, so that the data will be of the broadest use to researchers, and therefore we need to incorporate the farm sector. We noted above that our list of towns incorporates many very small places; so agricultural tasks that were typically undertaken in local population centers will already be included in our data. For example, non-farm agricultural workers such as nurserymen and gardeners were based in (or, at least, on the edge of) conurbations and therefore they are frequently recorded in the *UBD*. The situation is not completely satisfactory because we have almost certainly under-sampled bucolic villages (i.e. ones that cannot claim to be towns by dint of their importance in the transport or postal system). If some occupations – such as blacksmithing or plowmaking – were located systematically in such places then they, too, will be underrepresented in our sample. But any bias resulting from this is likely to be minor and it is really only the farm sector that is drastically under-reported.

We incorporate the farming population into our study using several contemporary and secondary sources, but particularly the survey of 400 farms undertaken by Arthur Young in c. 1770. Using an agricultural survey to complement an urban survey is obviously attractive in terms of maintaining consistency across sources, and Brunt has shown that the Young data are representative of English farming at that time.¹⁵ The survey reveals the ratios of each of four different types of workers to farmed acreage. These worker types are: servants (who lived on-farm in housing provided by the farmer); and laborers, boys and maids (who lived off-farm in their own housing).¹⁶ We matched these types to the two census occupations of “Farm servant (indoor)” and “Agricultural labourer (outdoor)”. If we take total farmed acreage and multiply it by the appropriate land-labour ratios then we can estimate the number of workers in each occupation.¹⁷ We know also from a large sample of tax returns that the average size of a farm in 1801 was 146 acres.¹⁸ Dividing total acreage by the average farm size enables us to infer the total number of farmers and graziers (a grazier being a farmer who kept only animals). Using the ratio of farmers to graziers in the Young sample, where there are 325 farmers and 13 graziers, we can then split up the total number of farmers and graziers into its two

¹⁵ Young, *Six weeks' tour; Six months' tour; Farmer's tour*. Brunt, “Advent”.

¹⁶ The numbers of workers per acre for each type of worker are 0.0110 (servants), 0.0109 (labourers), 0.0064 (boys) and 0.0064 (maids).

¹⁷ We take the total farmed acreage in 1801 to be 28 146 959, from Capper, *Statistical account*. Very similar figures are available from Comber, *Inquiry* for 1808. To generate county-level estimates of the agricultural population, we assume that the total farm workforce was distributed across counties in proportion to the total agricultural acreage in each county. We assume that farmed acreage was distributed across counties in 1801 in the same proportions as it was in 1867, the year of the first complete agricultural returns. In our town-level estimates we simply assume that the agricultural workforce was zero.

¹⁸ Allen, *Enclosure*, 73.

components. Note that these four occupations – farmer, grazier, labourer and servant – accounted for 1.5 million individuals out of a total 1.9 million for the entire farm sub-class in 1851. So, if we get these occupations right, then we are most of the way to our objective. These, and the other occupations in the sub-class, are listed in table 4 below.

Table 4. Employment in the English and Welsh farm sector in 1801 and 1851.

Census sub-classes IX.1	1801	1851
Land proprietor	30 315	30 315
Farmer	185 372	246 982
Grazier	7 415	2 430
Farmer's, grazier's wife	127 244	164 618
Farmer's, grazier's son, grandson, brother, nephew	86 346	111 704
Farmer's, grazier's daughter, grand-daughter, sister, niece	81 275	105 147
Farm bailiff	8 163	10 561
Agricultural labourer (outdoor)	667 083	952 997
Shepherd	9 675	12 517
Farm servant (indoor)	309 617	288 272
Others connected with agriculture	2 738	3 553
TOTAL	1 521 429	1 937 089

Since we have no independent information on farmers' and graziers' wives, sons, daughters and so on, we simply assume that the ratio of these relatives to the farmers and graziers themselves was the same in 1801 as it was in 1851. We similarly assume that the ratios of farm bailiffs, shepherds and others connected with agriculture to farmers and graziers was the same in 1801 as it was in 1851; since the numbers in these occupations are so small, it makes little difference what we assume.¹⁹ The occupation of land proprietor is less obvious. Farmed acreage fluctuates over time and therefore the number of farmers might be expected to fluctuate. But the total quantity of land does not fluctuate and it always has to be owned by somebody. So, unless we believe that there were significant changes in the average size of landholdings, the number of land proprietors must have been very similar in 1801 and 1851. In fact, the laws concerning the inheritance of land mitigated strongly against it being broken up into smaller units, so it is highly likely that the number of land proprietors was stable over this period. Our resulting total figure of 1.5 million is similar to the estimates of other researchers.²⁰

5. Other primary sector occupations. There is strong reason to believe that some other primary sector workers will have been underreported in the *UBD*, for several reasons. First, many primary producers would have sold their product onto a commodities market, rather than to the public; hence they would have had no reason to appear in the *UBD*. For example, fishermen sold their catch through the town fish market and had no reason to advertise. There is also a good chance that they would have been physically absent (i.e. at sea) when the person came to town to compile the *UBD*, making it even less likely that they would be listed. Second, some primary products were produced in a very limited number of locations, and generally not in towns – for example, copper from the Cornish mines. If it happened that none of those locations appeared in our sample then reflatting the sample to the national scale will simply lead to a massive underestimate of the number of workers in that sector.

¹⁹ We make the same assumption for sub-class IX.2, covering “Woodman” and “Others connected with arboriculture”, giving totals of 6 007 and 182 workers respectively.

²⁰ Allen, “Agriculture”, 107, has 1.4 million.

We address this problem as far as possible using other contemporary sources, particularly Parliamentary enquiries. The British Government was extremely interested in the fishing industry in the later eighteenth century, mainly because it was considered to be a training ground for seamen for the Royal Navy. Hence there were numerous reports produced around 1801, into each type of fish, and we used them to estimate the number of fishermen. Since particular ports specialized in particular fish, it was possible to reconstruct the workforce at the town level. We proceeded as follows.

The salmon fishery was limited to Scotland and Ireland.²¹ Lobsters were imported from either Scotland or Norway.²² The North Sea turbot fishery was monopolized by the Dutch.²³ Oysters were mostly gathered from the Kent coast for the London market, but we found no data on that fishery and were unable to include it; given the small size of the other fisheries (as we shall see shortly), this probably amounts to only a few hundred men. Most cod was imported from Newfoundland; the domestic whitefish industry (which included cod and haddock) was centered on Harwich and employed 300 men; we added 100 men for London.²⁴ The pilchard industry was based in Cornwall (notably at St Ives) and employed 3 228 fishermen and 4 500 fish curers.²⁵ The mackerel fishery was centered on Great Yarmouth and employed 500 men.²⁶ Lampreys were caught mostly in the Thames (although some also in the River Severn) to be used as bait in the cod fishery; there were around 160 men employed in this business.²⁷ The most complex fishery to quantify is herring because the operators could claim one of two kinds of bounty (subsidy) – either a per-ton bounty for the boat itself, or per-barrel bounty for the herring catches. So we need to be sure that we include vessels (and hence crew) operating under both schemes. Overall, we estimate that there were 2 070 English herring fishermen.²⁸ The number of herring fishermen (and, indeed, other types of fishermen) is surprisingly low. But it is largely because most fishermen were based in Scotland, and therefore lie outside the scope of our study; the Scottish herring fishery was twice as large (in terms of boats and men) as the English. The final fishery, and quantitatively the most important, was that for whales. There are good local and national data up to 1784,

²¹ BPP 1824, “Report from the select committee on the salmon fisheries of the United Kingdom.”

²² BPP 1785, “Report from the committee appointed to enquire into the state of the British fisheries, and into the most effectual means for their improvement and extension”, 21.

²³ BPP 1785, “First report from the committee appointed to enquire into the state of the British fisheries, and into the most effectual means for their improvement and extension.”

²⁴ BPP 1785, “Report from the committee appointed to enquire into the state of the British fisheries, and into the most effectual means for their improvement and extension”, 19. In 1784 there were 300 fishermen in Harwich catching whitefish. BPP 1798, “Further report respecting the British herring fishery”, 313, notes that 2 500 tons of whitefish came to London per annum from fishermen operating out of Harwich, London and Gravesend; we therefore added 100 fishermen to London to take account of this fact.

²⁵ BPP 1785, “Report from the committee appointed to enquire into the state of the pilchard fisheries”, 6. Data pertain to 1784.

²⁶ BPP 1785, “Third report from the committee appointed to enquire into the state of the British fisheries, and into the most effectual means for their improvement and extension”, 20. Data pertain to 1784.

²⁷ BPP 1786, “Second report from the committee appointed to enquire into the state of the British fisheries, and into the most effectual means for their improvement and extension”, 5. Data pertain to 1784.

²⁸ We work from BPP 1798, “Further report respecting the British herring fishery”, appendices 12 and 16. Data are averages for 1787-96; the annual figures were fairly constant and taking 1796 alone would make little difference ; we use the decadal average figures because they are broken down by port. We assume that the boats operating on the per-barrel bounty caught the same number of barrels per boat as those operating on the per ton bounty, and that the crew sizes were the same.

and from 1818 onwards, but the data are sketchier between those dates.²⁹ Hence Allen and Keay rely on Munroe's data for Kingston upon Hull and simply assume that it constituted a constant 37 per cent of total British whale oil output.³⁰ We drew the following data together. Jackson and Jones reveal that around 1801 there were 44 056 tons of shipping engaged in whaling.³¹ Taking six tons of ship per crew member generates a workforce of 7 343 men.³² Simple linear interpolation between 1784 and 1818 generates very similar estimates; this is what we would expect if the industry were growing fairly steadily.³³ We divided up the workforce according to the distribution of ships across ports.³⁴

Data on employment in the copper mining and ore-processing industries was likewise based on a Parliamentary enquiry.³⁵ The enquiry reports data for Cornwall alone, so we added an employment estimate for Anglesey – the only other production area – based on the fact that Anglesey produced around one third of total output.³⁶ England was the world's leading producer of copper at this time and the industry employed 10 000 workers in Cornwall and 5 000 in Anglesey. We still face the problem of allocating copper workers to towns. Another Parliamentary enquiry lists all the Cornish mines and their output in 1798 and we used this to plot the likely location of miners.³⁷ Except for a few mines around Fowey, which produced very little at this time, all the Cornish mines were located either away from towns or near towns that were (randomly) not in our sample. We therefore decided to add no copper workers to the town data, but to add them to the county and national totals. In this way, with the possible exception of Fowey, all copper miners will be correctly included in the enumeration. Tin was also mined in Cornwall and we infer employment (2 688 people) from total output in 1801 and output per worker for a large mine.³⁸ We followed a similar strategy

²⁹ BPP 1785, "Third report from the committee appointed to enquire into the state of the British fisheries, and into the most effectual means for their improvement and extension", appendix 27; BPP 1824, "Accounts relating to shipping and merchandize, the coasting trade and fisheries", 19.

³⁰ Allen and Keay, "Bowhead whales"; Munroe, "Statistics of the northern whale fisheries".

³¹ Based on customs data, Jackson, *British whaling*, 82, gives an average for 1800-4 of 24 980 tons operating in the northern whale fishery (84.2 ships averaging 297 tons each); based on *Lloyd's Shipping Register*, Jones, "British southern whale and seal fisheries", table 1, gives 19 076 tons of shipping operating in the southern whale fishery (which, given the 296 tons per vessel reported in table 5 of the same paper, generates an additional 64.4 vessels). This takes the total to 149 vessels. We thank Bjørn Basberg for bringing these sources to our attention.

³² Jackson, *British whaling*, 129, gives data for several years on tons per man. They generally range between six and seven and the lower figure prevails in periods when ships were smaller (as they were around 1801); hence we take six tons per man.

³³ Consider two primitive methods. First, linearly interpolate the national total of ships between 1784 and 1818, giving an estimated total of 185 ships in 1801. Alternatively, note that the percentage of ships operating out of Kingston upon Hull rose from 10 per cent in 1784 to 20 per cent in 1818; if it were 15 per cent in 1801, then this would predict a national total of 167 ships. This tallies fairly well with the 149 ships enumerated by Jackson and Jones. Most importantly, one would have to interpolate the tonnage per ship, which increased from 125 to 325 over the period and which we might expect to be around 225 tons in 1801; the true value was 297 tons. Assuming six tons of ship per crew member generates an estimated employment in the whale fishery of 8 257.

³⁴ Jackson, *British whaling*, 88, gives port data for 1790; Jones, "British southern whale and seal fisheries", part 2, table 1, gives port data for 1801.

³⁵ BPP 1799, "Report from the committee appointed to enquire into the state of the copper mines and the copper trade in this kingdom", 14.

³⁶ Hamilton, *English brass*, 209.

³⁷ British Government, "Report on the state of the copper mines and copper trade". BPP 1803, vol. 10, 651-750.

³⁸ Barton, *History of tin mining*, 19, 47, 52-3.

with slate mining. We inferred employment in 1793 in each production area (300 people in Cornwall, 200 in Cumberland and 867 in North Wales) using regional output data and labor productivity data for the largest Welsh mine (which produced around a third of national output).³⁹ We then added these workers to the county and national totals, but not to the town totals. Mining for iron ore, silver and lead was also geographically dispersed, and sadly not investigated by Parliament; its almost total absence from the *UBD* suggest that it was under-recorded, so we assume that employment in these occupations constituted the same percentage of the population as it did in 1851 and was distributed geographically in the same way. There was no zinc mining in England in this period but a bit of zinc processing (“calamine washing”), which is recorded in the *UBD*.⁴⁰

The biggest challenge is to estimate employment in coal mining. Fortunately, there are excellent secondary sources to guide us through the complicated primary sources.⁴¹ One third of English and Welsh coal was produced in the coal field that straddles the Northumberland-Durham border. The number of hewers (those who physically cut the coal) is known from 1804 onwards because data were collected in response to a controversial change in contracting arrangements and a subsequent strike. We also know from individual mine records that hewers almost invariably constituted one quarter of mine employees in that region (i.e. there were three people engaged in mine maintenance and surface operations for every hewer). Here we ignore other occupations connected with the coal trade, such as coal fitters, because they were recorded in the *UBD*; we are trying to estimate only those people who were employed at the mine. Our best estimate for the Northeast in 1801 is 16 368, which we divide equally between Northumberland and Durham, in the absence of more precise information. There are also direct employment information for the Forest of Dean; Cumberland (where we inflate from 1 300 to 1 500 workers to account for outlying areas); and the Gloucestershire-Somersetshire coal field (where we allocate one third to Gloucestershire). We have output estimates for 1800 for all 15 coal-producing counties. Therefore we are able to infer labour productivity for these four areas (the Northeast, Forest of Dean, Cumberland and Gloucester-Somerset); and we have direct information on labour productivity in Staffordshire. By dividing output in the other 11 counties by an estimate of labour productivity, we can estimate likely employment in coal mining in those counties. Labour productivity was famously high in the Northeast, being around 270 tons per worker per annum in 1801. Labour productivity was around 175 tons per annum in the Forest of Dean and Staffordshire; around 75 tons in Gloucestershire-Somersetshire; and around 50 tons in Cumberland. Flinn suggests that employment around 1801 would have been about 58 000, assuming that labour productivity outside the Northeast was 250 tons per worker per annum. His calculation is correct but seems unduly optimistic, given what we know about labour productivity outside the Northeast. We work on the basis that output per worker was 150 tons per annum in the 11 counties for which we have output data but no employment data. This generates a national English and Welsh workforce of 72 590.

6. The civilian government sector. We consider both the civilian and military branches of the government. The military branch was around ten times larger than the civilian branch (at around 325 000 servicemen in 1801) and was also by far the most problematic branch; we

³⁹ Williams, *Slate industry*, 5; Richards, *Slate quarrying*, 21-2.

⁴⁰ Jenkins, “Zinc industry”, 41–52.

⁴¹ Flinn, *British coal industry*, especially pp. 26-7 and 362-4.

postpone a consideration of that to the next section. Here we run through our treatment of the civilian branch.

A high proportion of civilian government workers in the early nineteenth century were engaged in raising revenue, divided in 1851 into the Inland Revenue and the Customs Service. In fact, the Inland Revenue was an amalgamation of several precursor branches that were extant in 1801 – the Board of Stamps (which levied charges to stamp or issue certain documents, such as attorneys licenses), the Board of Excise (which collected taxes on alcohol and similar goods), and the Board of Revenue (which collected the growing number of direct taxes in the late 1790s). The Public Record Office holds establishment data for each of these branches for 1801 or thereabouts, which we entered.⁴²

Another significant branch was the Post Office, and this is more difficult to quantify. A fundamental problem is that the Post Office employed people “on establishment” and “off establishment”. Employees on establishment were employed directly and often obtained additional non-salary benefits, such as pension rights; those employed off establishment did not. It is not entirely clear who was on or off establishment in particular periods, and whether people who were off establishment would have counted themselves as working for the Post Office when completing the census return. For example, many mail coaches in the late eighteenth century were run by private contractors; it seems likely that these men would have identified themselves as coachmen or coachmasters, rather than Post Office employees. But certain individuals on establishment were employed to deliver mail to particular areas (notably the “District Letter Carriers” servicing the London “rotations”); but they employed other people to do the physical delivery. It is possible that these people considered themselves to be working for the Post Office. However, at this time the recipient of a letter had to pay the postman to receive it, and some of these delivery sub-contractors may even have bought the right to deliver mail from the District Letter Carriers; then it would seem unlikely that they considered themselves to be employees of the Post Office. We have no systematic records of this type of sub-contracting, but it is likely to have been large: in London there was an *hourly* postal delivery at this time, which must have kept a lot of postal messengers employed.⁴³

⁴² Board of Stamps, “Reports, letters and memoranda, 1800-2”, 348-55. The letter of 22nd January 1802 from the Stamp Office lists their establishment on 5 January 1802. It definitely includes the central office (most of whom were printers and engravers) and the North Britain office. But it is not clear if it includes the Stamp Distributors (and Sub-Distributors) in each county (except London and Middlesex, which are definitely listed). It includes “46 stampers on the Old Establishment” and “32 stampers on the New Establishment”, but are they the county-level officers? We assumed not, and added the 62 county Stamp Distributors (and Sub-Distributors) listed in Board of Stamps, “Reports, letters and memoranda, 1800-2”, 281-7, letter of 20th August 1801; this brings the total establishment to 392. Board of Excise, “Totals of excise duties under the management of the Commissioners of Excise: establishment numbers and salaries”. This contains annual data from 1797 to 1836 on the establishment of the Board of Excise, both at head office and the ports, which totals 4 908 in 1801. Office of the Affairs of Taxes, “Annual accounts and establishment”, 59-62, offers a complete list of the establishment of the tax office in May 1797, totalling 284 persons. Customs Service, “A list of the commissioners and officers of His Majesty’s Customs in England and Wales, with their respective established salaries, for Midsummer Quarter ending 5th July 1801”. This lists every individual (by name) working in every port, including London and the central administration. In a few places a monetary allowance is made for clerks but we are not told how many are employed. We inferred the number by assuming that they earned 12.5 pounds per year (which seems typical from the rest of the document); this makes only a tiny difference to the total establishment of 1 812 persons.

⁴³ It was common for correspondents in London to exchange several letters per day in this period.

How can we start to quantify this problem? In the 1851 census, 10 410 people gave their primary employment as the Post Office. Yet – according to the Postmaster General’s first annual report in 1855 – 21 574 people worked for the Post Office.⁴⁴ Finally, the 1851 Post Office establishment book lists only 3 794 employees. How are we to reconcile these apparently inconsistent figures?

First, note that the 1851 establishment figure includes 816 staff at 23 regional offices but seems to include no town Postmasters, of which there were 9 973 in 1855 (and probably rather fewer in 1851 because the Post Office was expanding rapidly in this period – let us say 9 000 in 1851).⁴⁵ It seems likely that most town Postmasters would identify themselves in the census as an employee of the Post Office – although perhaps some Postmasters of small, rural Post Offices might not have listed it as their primary employment and would not, therefore, have been allocated to that category in the census. Some of the earlier establishment lists included town Postmasters, which is consistent with their being typically identified as Post Office employees.⁴⁶ Also, the 1851 census includes around 1 284 mature women (i.e. aged over 20 years) working for the Post Office; it seems likely that these were Postmistresses. Summing (say) 9 000 town Postmasters in 1851 and 3 794 establishment employees gives a total of 12 794, compared to a census total of 10 410. If 2 300 Postmasters regarded the Post Office as their secondary employer, then these figures would be reconciled. This seems to us to be the most plausible explanation. We therefore propose to calculate the 1801 figure for the Post Office by summing the establishment total and the town Postmasters.^{47 48}

Second, the establishment lists are quite consistent over time in reporting staff employed by the central administration and the London offices. The 1783 establishment list gives a total (excluding town Postmasters) of 1 158 people; the 1808 establishment list gives a total of 958.⁴⁹ Establishment lists for the intervening years are sparse and (in large parts) illegible but seem to offer similar totals (the documents have the same format and are around the same length). So a total establishment of 1 000 seems a reasonable estimate for 1801.⁵⁰

⁴⁴ Postmaster General, *First report*, 20.

⁴⁵ It is difficult to find the total number of Post Offices in each year until the advent of the Postmaster General’s annual report in 1855; there is no exhaustive official source.

⁴⁶ Such as the list of 1783, which seems to be particularly complete. See Post Office, “Establishment of the general Post Office, 1783.”

⁴⁷ The obvious alternative interpretation is that the 1851 census total comprises the Post Office establishment plus 9 152 messengers. However, since many of the messengers would have been employed indirectly – and since it is not clear where else the town Postmasters would have been returned – we feel that this is a less attractive interpretation. Suppose that we anyway wanted to pursue this line of logic. How could we estimate the number of messengers? It seems likely that it was proportional to the amount of Post Office business. We do not know the increase in the number of items sent in the post over this period, but we do know the increase in Post Office revenue (from £1 million to £2.2 million – see Clinton, *Post Office workers*, appendix 3). If the number of messengers rose proportionately then there would have been 4 160 in 1801. This would generate an estimated Post Office census return approximately 3 170 higher than the one that we calculate here.

⁴⁸ We assume that all town Postmasters in 1801 returned the Post Office as their primary employer in the census. This seems likely because they were all reasonably large towns; the ten-fold increase in the number of Postmasters up to 1851 inevitably led to the creation of Postmasters in locations with few inhabitants, where deliveries were not daily and where it would not have been economic for it to have been a primary occupation.

⁴⁹ See PO59/26.

⁵⁰ The *UBD* lists a total of 321 Post Office employees in its London volume, exactly the same as the Post Office establishment list for 1792. However, both of these lists exclude employees outside London, so are not comparable to other years and do not offer complete coverage.

Table 5. Employment in the Post Office in 1801 and 1851.

	1801	1851
Central office staff	1 000	2 978
Regional office staff	0	816
<i>Establishment</i>	<i>1 000</i>	<i>3 794</i>
Town postmasters	869	9 973
CENSUS TOTAL	1 869	10 410

There were a number of other government departments (“Offices of State”, as they were then known). For example, there was the Home Office, the Foreign Office, the Audit Office, the Army Office, the Navy Office and so on. But these were minor in terms of total employment. The breakdown of government employment for 1851 reveals that these branches employed 1 912 people out of a total of 53 678 in the national government sector; the vast majority of the 1851 total were employed in the various branches of the government revenue and the Royal dockyards, each of which we treat separately in this section.⁵¹ The London volume of the *UBD* lists the establishment of these various “Offices of State” and reveals a total of 1 087 employees. It seems perfectly possible that there was a 75 per cent employment increase in these branches of government between 1801 and 1851. Since we were unable to find extensive archival data on the establishment of particular government departments in 1801, we simply adopt the *UBD* data as they stand.⁵²

The largest civilian branch of the national government at this time – as large as all the others combined – was the Royal dockyards (Chatham, Deptford, Devonport, Portsmouth, Sheerness and Woolwich). Employment in the dockyards fluctuated with the war, peaking temporarily in 1801 at around 11 000 before falling in 1802 (with the short-lived Peace of Amiens) and reaching a new peak in 1812.⁵³ It is surprisingly difficult to unearth the exact numbers employed in each dockyard in 1801; but, fortunately, the distribution of the workforce across dockyards was virtually constant over time.⁵⁴ We are therefore able to infer the town totals from the observation of Devonport (otherwise known as Plymouth Dock) and the grand total reported in Moriss.

The East India Service (as it was denoted in the 1851 census) was still the East India Company in 1801; in several legislative steps, it was reduced from being a publicly traded company to being a department of the UK government by 1860. The earliest establishment list that we were able to find in the Company archive pertains to May 1817 and we adopt those figures here. Fortunately, the list is extremely detailed and we can be confident that the 4 114 persons returned were all employed in England (almost all of them in London, with a small outpost in Chatham).⁵⁵

⁵¹ British Government, *Census of Great Britain, 1851. Population tables II: Ages, civil conditions, occupations and birth-place of the people*, vol. 1, Supplementary Tables, cccxlix.

⁵² The only branch that we turned up in our search of the Public Record Office was the Audit Office ; see Audit Office, “Audit Office: establishment.” We preferred to maintain consistency across the departments by relying on the *UBD* data for all departments, rather than adjusting one only.

⁵³ Moriss, *Royal dockyards*, 106.

⁵⁴ Data for 1786 (Crawshaw, *History*, chapter 3, 53) and 1814 (Moriss, *Royal dockyards*, 109) have virtually identical employment shares for each dockyard; we averaged them to get an estimate for 1801 and then inferred total employment from the employment figure for Devonport, as reported in BPP 1803, “Sixth report of the Commissioners of Naval Enquiry: Plymouth yard, Woolwich yard”, 372-81.

⁵⁵ The East India Company archive is available at the British Library. The establishment list for 1817 is found at L/AG/30/6.

Another branch of government (broadly defined) is the Church of England. In principle, clergymen are reported in the *UBD* and we need look no further. Unfortunately, employment in the Church of England was not straightforward and we need to interpret the data carefully. Clergymen were allocated “Livings” – geographically-defined units, such as a parish with a vicarage, or a post at a cathedral – which came with an income stream. But the income stream from one of these livings was typically not sufficient to keep the clergy in the style to which they had become accustomed. The response of the Church hierarchy was to allocate many vicars more than one living each. Hence one clergyman might be the priest for two or three, or even more, parishes – thus combining multiple income streams; the average turns out to have been 1.6 livings per clergyman. The clergyman would then preach at each of his livings in rotation and there would be services only on certain Sundays in the month. Thus, although a parish had a church and an allocated clergyman, it did not necessarily mean that there was a clergyman resident there. We address this problem using the earliest clerical guide, which appeared in 1817 and which presents data on clergymen in several useful formats.⁵⁶ The largest part of the clerical guide presents an exhaustive alphabetical list of Church of England livings (excluding the establishment of cathedrals, which is listed elsewhere in the book). Another part presents an exhaustive alphabetical list of clergymen and all the livings that each of them possessed (again, excluding cathedral clergy). We used these two data series as follows. For each of our towns, we noted the number of clergymen in post and the number of livings *in total* that those clergymen held between them; then we inferred the number of *de facto* clergymen in that town. (So, for example, if three clergymen in a town held nine livings between them then the *de facto* number of clergymen in that town was $3 \times (9/3) = 3$. There were three clergymen and each of them spent, on average, one third of their time in the town.) This is the number of clergymen that we report for each town in our sample.

For the national total of clergymen, we simply took the number of clergymen featuring in the alphabetical and cathedral lists (approximately 8 142).⁵⁷ Note that one can infer the average number of livings per clergyman by dividing the national total of livings (approximately 12 926) by the national total of clergymen, which gives a figure of 1.59 livings per clergyman. Alternatively, sampling the first 100 clergymen and noting the number of livings per individual gives an average of 1.59; we thus find that the numbers are quite consistent when considering different aspects of the data set. We estimated the county totals of clergymen by multiplying the total number of clergymen by the distribution across counties, which we inferred in two ways. First, we sampled the alphabetical list of livings to give a distribution across counties, adding in cathedral establishment.⁵⁸ Second, we used the patronage lists from the end of the book to construct a county distribution. We prefer the first

⁵⁶ Gilbert, *Clerical directory*. Since the structure of the Church of England was static – no churches were being constructed or demolished in this period – the number of livings would not have changed significantly between 1801 and 1817 and hence we believe that this is a good guide to the number and location of clergymen in 1801. In fact, the dates are sufficiently close together that many clergymen in post in 1817 were probably already in post in 1801.

⁵⁷ We excluded 176 faculty at Oxford, Cambridge and various schools (such as Eton). It was a requirement for these people to be in religious orders before obtaining their teaching positions; but – since they were generally teaching a variety of academic disciplines, rather than practising as clergymen – they are more properly categorized as teachers.

⁵⁸ We took a 17 per cent random sample (36 pages out of 208), using pages 1-4, 25-28, 51-4, 75-8 and so on up to 201-4.

method because the patronage lists do not cover all livings (only around 4 500) and we were concerned that they might be geographically biased in some way; and they do not divide Yorkshire into the three Ridings. In fact, the distributions generated by the two methods are anyway very similar (a correlation coefficient of 0.80).

Another group that we consider here is law enforcement. By modern standards, there were very few police employed in this period; English society was in transition from a medieval system of communal law enforcement (calling out local burghers in the “hue and cry”) to a system of professional law enforcement that started in earnest with Sir Robert Peel’s Metropolitan Police in 1829. There was some move to professional policing in London in the 1790s with the establishment of 139 officers at eight police stations; we include data on these, drawn from the parliamentary reports.⁵⁹ The *UBD* also reports the existence of constables in various towns. But these were clearly secondary, part-time duties taken on by people in addition to their regular business (see, for example, the constables listed in Kingston upon Hull); it is not obvious that these positions were even paid. We therefore decided not to categorize them separately as law enforcement officers.

More quantitatively significant was the prison service (as it would now be called) and the prison population. For the prison population we mostly rely on Howard’s prison census of 1776 because it is exhaustive and we have no reason to suppose that the prison population changed significantly up to 1801; in fact, one of Howard’s main complaints was that the prisons were at or over capacity (does that sound familiar?), so there was little room for growth in the prison population of 3 863.⁶⁰ There were additionally 1 410 convicts held on prison ships in 1801, awaiting transportation to New South Wales; since New South Wales was unable to receive further convicts at that time, the prisoners mostly stayed on the ships until they died or were pardoned.⁶¹ We assumed that the geographical distribution of the 1 410 convicts onboard ships in 1801 was proportional to the crews of the three prison hulks in Falmouth, Plymouth and Portsmouth⁶²; this was approximately true for the 1 456 convicts held onboard in 1804.⁶³

Finding the number of jailers is much more difficult. The *UBD* reports people who identify themselves as jailers: they total around 50 people and this appears to sit uneasily with a total of 249 prisons in England and Wales. However, many jails in this period were private and the jailers either received a very small salary from the government or none at all, making up their income by charging prisoners for board and lodging and engaging in another occupation.⁶⁴ Bizarrely, some prisons were also inns (such as at Tower Hamlets and Canterbury) and the innkeeper accommodated both freemen and prisoners in the same establishment. Thus many jailers may have had some alternative primary occupation and it is more comprehensible that so few people identify themselves as jailers. But just how plausible is such a small number of jailers? First, note that half of all prisoners were incarcerated in London. Second, the modal number of prisoners per prison outside London was zero, and the

⁵⁹ BPP 1810, “Twenty-eighth report”, appendices I1 and K1.

⁶⁰ Howard, *State of the prisons*. Note that this figure includes convicted felons and debtors and those held on remand. In this period it was quite common for prisoners’ families to live with them in gaol; these individuals are not included in this figure.

⁶¹ For a fascinating firsthand account of the machinery of British incarceration on prison hulks at this time, and its inhumanity, see Waterhouse, *Journal of a young man of Massachusetts*.

⁶² Admiralty, “List Book: showing the disposition of ships, names of officer & c.”

⁶³ BPP 1813-14, “Third report”, appendix D.

⁶⁴ The following discussion draws on the detailed descriptions in Howard, *State of the prisons*.

median was only two; that is, most prisons were virtually or entirely empty. Hence it seems likely that the keepers of these prisons were not employed full-time as jailers. Note also that half of all prisoners were debtors and they benefitted from an open prison regime: they were locked up only at night and in many cases their wives and children lived with them. So it was more like being under house arrest than being in prison, as we think of it today. Hence there was not much call for jailers. All the large prisons were in London and these were the only ones that would have required multiple jailers (or turnkeys, as they were known), such as Newgate – where hundreds of prisoners were incarcerated – and Giltspur Street. Data for these prisons suggest that there were around 20 prisoners per jailer and we thus infer that there were 95 jailers in London from the number of prisoners.⁶⁵

The final sector that we consider is the workhouse. We know that in 1776 there were 1 963 workhouses in England and Wales.⁶⁶ Since there were no major reforms of the Poor Law until 1834, it seems likely that the number of workhouses was largely unchanged up to 1801; this is our working assumption. We therefore assume that there were 1 963 Relieving Officers. On the one hand, this will be an over-estimate because some of the workhouses were very small (a capacity of only 3 people) and the Relieving Officer would have been a part-time appointment; on the other hand, some of the workhouses were very large (a capacity of 200 people) and there would have been multiple full-time employees. So we feel that the total for Relieving Officers is probably fairly accurate.

The total capacity of all workhouses in England and Wales in 1776 was 89 685. It seems likely that the system was operating at, or close to, full capacity in 1801 because there had been several harvest failures and pauperism was rife. Most paupers were actually supported outdoors (i.e. did not go into the workhouse but were subsidized to live at home) because it was cheaper and local taxpayers therefore had little incentive to build more workhouses.⁶⁷ In 1851 there were 126 488 workhouse occupants in England and Wales (131 926 in Great Britain), roughly half of them male.⁶⁸ Of these, 54 per cent had no stated occupation. Why? It is notable that 47 per cent of workhouse occupants were children under 15 years of age or elderly people over 74 years of age; generally, we would not expect these groups to have (or ever to have had, in the case of children) an occupation. It seems likely that the proportions were similar in 1801, since whole families were committed to the workhouse and this perforce included many children. Overall, in 1851 there were 80 261 “Paupers of no stated occupation” in Great Britain, of whom 70 594 were enumerated in the workhouse. Again, we assume that the proportion was the same in 1801 and this generates a total of 54 688 “Paupers of no stated occupation” in England and Wales. We distribute this total around the country in proportion to the local capacity of workhouses; rounding errors arising from summing across 1 963 workhouses then reduces our overall estimated total to 54 509.

7. The military. Let us now turn to the military establishment, which was ten-fold larger than the civilian establishment and totaled around 325 000 men (200 000 in the army and 125 000 in the navy). This is only 3.5 per cent of the 1801 population of 10 million, but it is nearly 14 per cent of the adult male population. And the whole amount is allocated to the service sector.

⁶⁵ BPP 1813-14, “Report from the Committee on the State of the Gaols of the City of London”.

⁶⁶ British Government, *Abstract of the returns made by the Overseers of the Poor* (London, 1776).

⁶⁷ May, *Economic and social history*, 119-25.

⁶⁸ British Government, *Census of Great Britain, 1851. Population tables II: Ages, civil conditions, occupations and birth-place of the people*, vol. 1, Table XLVIII, cccxii-cccix.

So the size of the military establishment has a very large bearing on the measured distribution of labor across sectors. The key issue is how much of the military establishment should be counted in the census. There are subsidiary issues concerning the distribution across officers and other ranks, and across active and inactive officers. Many of the same problems arise with regard to merchant seamen, so we also treat that occupation here.

There is an enormous volume of data available on the Royal Navy and the British Army. It is therefore surprising that it is so difficult to calculate how many men were employed in the armed forces in England and Wales, and especially difficult to categorize them according to the detailed occupational structure of the census. A fundamental problem arises from the fact that much of the military was (and still is) serving overseas. Should these people be included in the census? The obvious answer is “no” and this would be consistent with the modern treatment of UK civilians.⁶⁹ Current guidelines state that UK civilians who are abroad for less than six months in the year of the census are to be included – even though they are not physically present on census day – whilst those who are abroad for longer than six months are to be excluded. The rule is symmetric for foreigners who are present in the UK on census day. Logically, servicemen who are posted abroad for more than six months (such as those serving in Afghanistan) would therefore not be counted in the enumeration. But they are. If they have a permanent UK address (which can include an address at a barracks) then they will be counted as living in the UK.⁷⁰ This is perfectly consistent with the treatment in the 1801 census, when all military personnel were simply added to the population total. Note, however, that the origin and validity of the numbers reported in the 1801 census are unclear. It is suggested that the figure for the British Army includes everyone serving in British and Irish forces (including Irishmen in Irish regiments based in Ireland, which should logically be included in the Irish census).⁷¹ This would obviously generate an overestimate of the number of army personnel. The figure for the Royal Navy seems to be based on the official establishment, rather than the number of men actually mustered. Given that the navy was notoriously understrength, this would lead to a significant overestimate. We address these issues in more detail below.

Unfortunately, simply adding military personnel to the population total (as was done in 1801 and in the most recent census) is not consistent with the way that the census has been reported for the rest of the nineteenth century – as reflected in, for example, Mitchell’s *Historical statistics* and the census reports of 1851 and 1881 (which Mitchell *de facto* reproduces).⁷² Rickman was the first Registrar General and pioneered the measurement of population in the UK; he was held in high regard at the time, and has been since that time. Until 1841, whilst Rickman remained Registrar General and supervised the census, military personnel continued to be included in the same manner as 1801. But changes were made thereafter, as explained most clearly (or least opaquely) in the census report of 1851.

The first adjustment, made in 1851, was to deduct Irishmen serving in the army and navy from the British census returns.⁷³ This is inappropriate. Irishmen who enlisted for more than six months (i.e. all of them) and came to reside in Great Britain should be enumerated

⁶⁹ Office of National Statistics, *Census 2001: definitions*, 17.

⁷⁰ Personal communication with the Census Office.

⁷¹ Registrar General, *Census of Great Britain, 1851: population tables*, vol. 1, xxiii. The number reported there for 1801 slightly exceeds the establishment figure given elsewhere – as we discuss below – but is close enough to be plausible.

⁷² Mitchell, *Historical statistics*.

⁷³ Registrar General, *Census of Great Britain, 1851: population tables*, vol. 1, xxiii.

with the British population; only those who were serving overseas (primarily in Ireland) should have been subtracted. It is also problematic that the Census Office did not know how many Irishmen were serving in 1801; they simply assumed that it was the same proportion as in 1851. This is open to obvious objection, since one important route out of the Irish Famine of the late 1840s was to join the British military – so the proportion of Irishmen was probably higher in 1851 than in 1801. In table 6 below we track the changing (declining) estimate of the British military workforce in 1801; the years at the head of each column refer to the date of the estimate *for 1801*.

Table 6. Estimates of 1801 military and merchant marine employment.

Year in which the estimate for 1801 was made:	1801 to 1841	1851	1881	2011
British Army	198 351	111 119	55 559	86 195
Royal Navy (including Royal Marine Corps)	126 279	70 743	35 372	60 593
Merchant seamen	145 968	81 773	40 887	123 051
Convicts on prison ships	1 410	0	0	1 410
TOTAL	472 008	263 635	131 818	271 249

The second adjustment, made in 1881, was to include in the census only those soldiers serving at home, or Royal Naval personnel serving in British waters. The census office attempted to estimate these figures back to 1801. They do not tell us how they did this, but the figures for troops at home in 1801, 1811, 1821 and 1831 all happen to be exactly one half of the total military establishment – so we suggest that they simply assumed that one half of service personnel were deployed at home. Thus the figures for the nineteenth century, as adopted by Mitchell and others, have been prepared on a consistent basis – even though the figures for the first four censuses are estimated, and the basis of the figures differs from the current census.

We emphasize that the first adjustment, in particular, is pernicious. *De facto*, the figures reported by the Census Office in 1881 assume that half of each nationality was serving at home and add these figures to the English, Welsh, Scottish and Irish population totals respectively. But this is clearly nonsense. It is well known that many Scots and Irish served in English regiments and would have been permanently resident in England. They should therefore be included in the English census, just like other permanent migrants from Scotland and Ireland. This adjustment therefore leads to an underreporting of the military establishment in England. Not only are we subtracting Englishmen serving abroad, we are also neglecting to add Welshmen, Scots and Irishmen serving in England. A similar logical inconsistency arises in the case of prisoners of war. Enemy prisoners of war are not recorded in the census, despite being resident in England; this would be logical if English prisoners of war being held in France were included in the enumeration instead, but they were not included either. This is despite the fact that the existence of such prisoners was recorded in other sources (for example, the Liverpool port book records merchantmen that were captured by the French, along with the identities of their crews). This omission may not be serious for 1801 but could well be for 1811, by which time almost a decade's worth of prisoners of war would have accumulated in English prison ships.

Note that a third difficulty arises from the sharp fluctuations in the size of the military establishment. Britain was mobilizing as rapidly as possible from 1793 to 1801; but mobilization was put on hold in 1802 (or maybe went into reverse), owing to the Peace of Amiens; and then it accelerated again when war resumed in 1803. So data from any year

around 1801 are unlikely to be representative of 1801 itself. For example, there were probably twice as many men in the armed forces in 1813 as there were in 1801.

We circumvent these three problems by collecting data directly on the number of soldiers and sailors serving in Great Britain, or home waters, in 1801.

Fortescue's exhaustive fourteen-volume history of the British army reports the total establishment of the British Army in 1801 and where it was deployed.⁷⁴ His figure for "Other ranks" (that is, not officers) deployed at home is 79 732 (assuming that the artillery was deployed proportionately with the other regiments).⁷⁵ We then need to add officers to this figure. There were 9 319 officers inscribed in the 1801 Army List and we assume that officers were deployed proportionately with "Other ranks", giving a home establishment of 4 034.⁷⁶ We then used the location of barracks to allocate these individuals to towns and counties.⁷⁷

Another complication is the use of half-pay officers. Once an officer had attained a certain rank, he maintained that rank in wartime and peacetime. But officers not actively employed were reduced to half pay; they were expected to wait around doing nothing, to be called upon as the Crown required. So merely knowing the size of the active military establishment at any particular date (a figure which is typically available from the Parliamentary records, since they had to vote money for sustenance and explicitly set out the number of men for which they were paying) does not tell you the total number of officers. Moreover, you would expect the number of half-pay officers to be inversely correlated with the number of officers on active duty, so we cannot simply assume that the number of half-pay officers is constant over time. The Army List again allows us to address this issue for the army, reporting 2 429 officers on half pay in 1801, whom we assume to have been spread evenly across English and Welsh towns. The Army List (surprisingly) also reported the number of Marine officers on full and half-pay (707 and 438 respectively).

From the Parliamentary records we know that the total Royal Naval establishment in 1801 was 131 959, of which 24 200 of were Royal Marines. But we have to be very careful here because the navy was perpetually shorthanded – hence the traditions of giving signing-on bonuses or even press-ganging people in order to find enough men. So we really want to know the actual numbers serving, not just the official establishment. We also need to divide up the fleet into the part serving in home waters and the part serving abroad. There are some records that can help us in this task. On the first day of each month, the Admiralty recorded

⁷⁴ Fortescue, *History of the British Army*, vol. 4, appendix D, 940. His data are based on reports in the *Journal of the House of Commons*.

⁷⁵ In fact, we adopt the number 79 734. When we allocate the soldiers to towns and counties – using the method that we discuss below – there is a rounding error that adds two soldiers to the total. In order to maintain consistency between the county totals and the national total, but adopt the sum of the county totals as our national figure. Small rounding errors of this nature occur for various occupations.

⁷⁶ War Office, *List of all the officers*.

⁷⁷ The continual expansion of the army in this period created a continual problem of barrack capacity and there were various parliamentary reports on the subject, including one that gave the capacity and location of all barracks in 1802; see BPP 1806, "Fourth report", appendix 56B. Total barrack capacity was 74 640, compared to a home army establishment of 83 765. The latter figure includes officer, however, and it may be the case that officers generally lived in lodgings outside the barracks, thus bringing the barrack requirement down to 79 732. Presumably some soldiers were either kept in tented encampments (as on Dartmoor in 1806-9, whilst the prison was being built) or in barracks that were over capacity. For convenience, we assume the latter and reflate the town barracks figures by 83 765/74 640. We assume that half-pay officers were distributed geographically evenly across towns.

the deployment of each ship and its official complement.⁷⁸ This reveals that, on 1st June 1801, 319 out of 621 vessels were deployed in home waters. This may seem surprisingly high but it is consistent with world events at that time: most of the Royal Navy was concerned with preventing a French invasion of England and hence based in home waters. The Channel squadron (under Cornwallis) operated mostly out of Portsmouth. The North Sea squadron (under Dickson) and the Baltic squadron (under Pole) operated out of Chatham. The latter, in particular, spent much of its time anchored in the Nore and forayed into Scandinavia for only a few months each summer. By the late nineteenth century the situation had changed radically and the Mediterranean Fleet was by far the largest, protecting the passage to India, and there were also naval units based in the Far East. But this was not true in 1801. We allocated the crew of each ship to the port from which it operated; ships in the Nore and the Downs were allocated to Chatham.

How many sailors were onboard these ships, or based at shore establishments in the Royal Dockyards? This information is reported monthly in the ships' muster books, which were transcribed into ledgers held at the Admiralty.⁷⁹ We took the data for 1st June 1801. As well as reporting data on the crew, it also reported the location of the ship. This mostly meshed with the deployment data in the Admiralty Lists, as you would expect. Where there were discrepancies, we generally preferred the muster data because they seemed to be more up to date. Why? For one thing, a number of the ships were refitting at any given time. Depending on the length of the refit, this could result in the crew being reallocated to other ships, given the constant shortage of crew. If the muster book reported that a particular ship was in Chatham being maintained by a skeleton crew, rather than operating in the North Sea as the deployment data suggest, then it seems most likely that the ship had indeed left its deployment temporarily to make repairs in the dockyard.

Of the 319 ships in home waters, a shocking 148 are not mentioned in the muster rolls. Why? We suspect that most of them simply had no crew. Gunboats constituted 94 of these vessels (of which 57 were in the roadstead of Spithead, outside Portsmouth harbour). Gunboats at this time were small boats with one large gun in the bow and another in the stern, designed to operate in shallow water and repel enemy beach landings.⁸⁰ Probably these vessels were either manned by fencibles (that is, local militia who were called up only when an invasion was expected) or they were left unmanned until needed (when men would be seconded from heavy ships anchored safely in Portsmouth harbor, for example). Some of the other vessels were fireships (which would be manned by scratch crews only when they went into action). There were also a number of "Receiving ships", where new sailors were sent for assessment and training; they had little permanent crew, and it is not clear how many men would have been under training in summer 1801 (when peace was being negotiated). We therefore assume that the crew of all these types of vessels was zero, unless otherwise stated in the muster roles. There were also a number of static ships, particularly prison ships, hospital ships and store ships. None of these ships have a reported muster role, so we assumed that their muster role was equal to their nominal complement. This would be unusual, compared to the other ships, but we believe that it is plausible. They were probably manned by sailors who could no longer man the fighting ships, such as invalids, who were easier to find and more willing to serve

⁷⁸ Admiralty, "List Book: showing the disposition of ships, names of officer & c." We thank Jeremiah Dancy for pointing this out.

⁷⁹ Admiralty, "Muster Book: showing the names of ships, their stations & c."

⁸⁰ For a nice description, see www.historyofwar.org/articles/weapons_gunboat_napoleonic.html.

than able-bodied men in frontline ships. Since the total crew for all these ships was around 1 500 men, it makes little difference if we are slightly overestimating. The muster roles record 46 970 men (excluding officers) serving on 1st June 1801; this compares to a notional complement of 76 907 for the same ships.

There are two ways of inferring the number of officers serving on these ships and these give similar results. First, the Admiralty List Books list the Lieutenants serving on each ship, giving 701 of them in total for the Home Fleet.⁸¹ If Royal Marine officers were distributed evenly across the Marine Corps, then the 9 146 Marines serving in the Home Fleet were accompanied by 277 officers. Second, we can draw on unpublished material kindly provided to us by Jeremiah Dancy.⁸² He has compiled a database of 27 174 men serving in the Royal Navy, based on a stratified sample of Royal Naval ships commissioned between 1793 and 1801 in Chatham, Portsmouth and Plymouth. Dancy's sample reveals the proportion of Royal Naval and Marine officers in the crew of seagoing vessels (3.37 per cent of and 3.12 per cent respectively), which translates to a total of 709 Royal Navy officers and 295 Royal Marines officers in the Home Fleet. These two sets of numbers for Royal Navy and Marine officers are comfortingly similar; we adopt the direct observations from the Admiralty Lists for the number of Lieutenants in 1801, but we will need to use Dancy's data for a further set of calculations. First, reflate the Royal Navy officer figure to account for Midshipmen, who comprised 63 per cent of the officer corps (according to Dancy's data); this gives a total of 1 912 Royal Navy officers. Suppose that there were a further 150 officers employed ashore, such as in the Admiralty building itself and the Royal dockyards; then we are up to 2 062 Navy officers on the home station in total.⁸³

How can we deal with the issue of half-pay officers? The Navy List recorded the enlistments, promotions, deaths and retirements of all Royal Navy officers. This is available as an electronic database which reports the service histories of each of the 11 152 officers who served at some point between 1793 and 1815.⁸⁴ We sampled the first 2 379 records in the data base – that is, everyone whose family name began with the letters A, B or C – and found that 1 007 of them were serving in 1801. Pro-rating this 20 per cent sample to the officer population, we estimate that we were 4 720 officers on the Navy List in 1801 (that is, both full pay and half-pay officers).

However, a further complication arises in the case of officers below the rank of Lieutenant, which was the lowest recognized rank and the lowest to be paid directly by the Royal Navy. Boys who set out on a naval career typically went to sea as “Servants” (to an officer), “Volunteers” or “Midshipmen”. The boys were effectively apprenticed in their teens (some even as young as eight or ten years old) to a serving officer. Navy officers received a fixed stipend to cover the wages of their apprentices, with the total amount of the stipend (and the number of apprentices per officer) rising with rank; an admiral might have 20 or 30 such apprentices. Boys had to serve with the Royal Navy for at least six years before being eligible to take the examination for Lieutenant. We can therefore infer that anyone who attained the rank of Lieutenant between 1802 and 1807 (inclusive) must have been a Midshipman in 1801 and this is the basis on which we estimate the total number of Midshipmen in 1801. This is

⁸¹ Admiralty, “List Book: showing the disposition of ships, names of officer & c.”

⁸² Dancy, “Naval manpower”.

⁸³ We assume 15 officers in each of Chatham, Devonport and Portsmouth Dockyards; 9 in each of Deptford, Sheerness and Woolwich Dockyards; one in each of 43 county recruiting offices; and 35 at the Admiralty in London.

⁸⁴ Marioné, *Complete Navy List*.

obviously an underestimate because some took longer than six years to come up for their Lieutenant examination, so some Lieutenants who qualified in 1808 and 1809 would also have been serving as Midshipmen in 1801. We ignore these individuals because the total number is likely to be fairly small and we have no way of estimating it with accuracy. We estimate that, out of the 4 720 appearing in the Navy List in 1801, 3 121 of them were Lieutenant or above and hence eligible for half pay.

We now need to estimate the total number of officers (Lieutenant or above) actively employed globally in 1801; subtracting this number from the Navy List total will give us the number of half-pay officers. Employing once more the two methods used above – Dancy’s sample and Admiralty List Books – we get estimates of 1 271 and 1 278 officers respectively. As previously, suppose that shore employment, such as the Admiralty and the dockyards and the county recruiting offices, takes the total to 1 421 officers. Then there were around 1 700 officers on half-pay (=3 121 – 1 421).⁸⁵

Two other military categories are Greenwich Pensioners and Chelsea Pensioners, which comprised injured members of the Royal Navy and the British Army respectively. Some of these were in-pensioners, accommodated in the Royal Hospitals at Greenwich and Chelsea, but the majority were out-pensioners. We know the numbers of each type of pensioner but not the physical location of the out-pensioners; in the absence of any better strategy, we simply assume that they all lived in London. In 1801, Greenwich had 2 410 in-pensioners and 3 086 out-pensioners.⁸⁶ In 1806, Chelsea had 476 in-pensioners and 20 805 out-pensioners.⁸⁷ We also added 35 nurses to the database to reflect the Royal Navy medical establishment at East Stonehouse (Devonport).⁸⁸

Finally, let us consider merchant seaman. We include them in this section because the same fundamental problem arises: should men serving abroad be included in the enumeration? The rule is analogous to that for the military: merchant seamen employed in home waters should be included and those serving in foreign waters (i.e. on long voyages) should not. Since we are considering 146 000 men, this is another quantitatively important issue. In principle, this problem is soluble. In 1696, an Act was passed to take a compulsory levy on seamen’s wages – a sixpence per man per month to finance a fund for invalid seamen. Later, this sixpence levy went to the Greenwich Hospital and an additional shilling per month was levied to finance the Seamen’s Fund. Collecting the levy required a tax-gathering machinery and so the captain of each vessel was obliged to make a regular return of his crew to the Port Captain in his home port. Vessels trading in home waters had to make a quarterly return and those trading in foreign waters had to make a return at the termination of each

⁸⁵ Whereas two-thirds of serving officers were Midshipmen, only around one-third of those appearing in the Navy List in 1801 were Midshipmen. This might seem worrying but is actually easily explained. First, we underestimate the number of Midshipmen on the Navy List in 1801 because we assume that they served only a six-year apprenticeship; if the average were 12 years then our estimate would be twice as high. Second, many Midshipmen would never have made it to Lieutenant (owing to premature death or failing the examination) and hence never have appeared on the Navy List. Third, even though the Navy List generates an underestimate of the number of Midshipmen serving in 1801, it does not generate an underestimate of the number of Lieutenants and above, which is what we need to infer the number of officers on half-pay, so there is no bias in our results here.

⁸⁶ BPP 1806, “The fourteenth report of the Commissioners of Naval Enquiry”, appendices 33 and 54.

⁸⁷ BPP 1806-7, “Return of the number of out-pensioners of the establishment of Chelsea Hospital”. By 1795 there were already 16 955 out-pensioners; see BPP 1797-8, “Thirty-fourth report from the select committee on finance. Chatham Chest, Greenwich Hospital and Chelsea Hospital”, appendix C.10.

⁸⁸ BPP 1803, “Seventh report of the commissioners of naval enquiry. Naval Hospital at East Stonehouse. Le Caton hospital ship”, appendix 1.

voyage. Some of these records survive from as early as 1747. Our idea was to analyze these returns and – in light of whether they were quarterly or by voyage – calculate the number of seamen in each category. This proved to be impossible because we found complete returns for only five ports (Dartmouth, Ilfracombe, Liverpool, Plymouth and Whitby).⁸⁹ This is clearly not a random sample of ports, and the ports differed very strongly in their orientation: 90 per cent of merchant seaman in Liverpool operated in foreign waters whilst virtually 100 per cent of merchant seamen in Ilfracombe and Plymouth operated in home waters. Without a proper weighting scheme for the ports, we could not hope to estimate the national distribution of merchant seamen. But there is another solution. The government collected data on the number of vessels engaged in the coasting trade (i.e. operating in home waters).⁹⁰ In 1814 there were 21 550 vessels (2 414 170 tons), in 1824 there were 21 280 vessels (2 348 314 tons) and in 1834 there were 19 975 vessels (2 213 355 tons). Given the striking constancy of these figures, it seems reasonable to suppose that there were similarly 21 550 coasting vessels operating in 1801. How many crew operated each vessel in home waters, on average? Vessels from Dartmouth, Ilfracombe, Liverpool, Plymouth and Whitby averaged four, three, five, six and six crew respectively, giving a weighted average of 5.71 crewmen, based on 1 530 seamen working 268 vessels. This suggests that in 1801 there were 123 051 merchant seamen operating in home waters.

Can this possibly be true? Surely most merchant seamen were engaged in highly profitable trading voyages to the East and West Indies and North America, or bringing naval stores from the Baltic? Apparently not. In Plymouth – site of the largest Royal Dockyard and ropery – there were only six ships operating abroad (all in the Baltic) out of 62. This can partly be explained by the use of foreign ships (especially ships registered in neutral countries) to bring naval stores into Britain; this was less risky because neutral ships could not be captured by the French, and it effectively imported labor services (i.e., skilled seamen) at a time when they were in very short domestic supply. This point is easily verified by looking at the names of the ships, and their captains, who delivered hemp to the Royal dockyards.⁹¹ In Liverpool in 1801 – the hub of the Triangle Trade – only 6 939 merchant seamen engaged in voyages to Africa or the Americas (and none to Far East). Suppose that Bristol was the same and London twice as large; then there would have been 28 000 merchant seamen operating in foreign waters. This tallies fairly well with 123 000 operating in home waters and 146 000 in total. We distributed the merchant seaman around the country in the same proportions as 1851. Whilst some ports might have grown and others shrunk in importance, we feel that – to a first approximation – this is probably a reasonable assumption.

8. Cotton manufacturing. Our results suggest that the largest group of non-agricultural workers in 1801 was in cotton manufacturing. Our estimates of the number of workers in cotton manufacturing are somewhat lower than those reported by Mitchell for 1806.⁹² Mitchell's figures are already modest because they do not include all cotton manufacturers, as he remarks in his notes to the table: he excludes hand spinners, as well as the winders and

⁸⁹ Available at the Public Record Office at BT 98/8, BT 98/1, BT 98/61, BT 98/109 and 110, and BT 98/138 respectively. There may be other extant records available in local archives. But this would not solve the fundamental sampling problem, since we do not know the size and trade orientation of every port.

⁹⁰ BPP 1847, "Report of the commissioners appointed to inquire into the condition, prospects, and management, of the Merchant Seamen's Fund", appendix 8.

⁹¹ BPP 1806, "Twelfth report of the commissioners of naval enquiry", appendix 14.

⁹² Mitchell, *Abstract*, 367.

warpers working with the hand-loom weavers. His estimates could therefore be taken as a lower bound on the true figure, especially since virtually all weavers were still using the hand-loom in 1801. Note, however, that labor productivity and total output were both rising very rapidly in this period. On the one hand, the rise in labor productivity reduced the number of workers required to generate a given output of cotton yarn or cloth. But, on the other hand, the rise in total output increased the number of workers required in the industry. It is a purely empirical question as to which effect dominated and at what pace, so total employment could plausibly have gone up or down between 1801 and 1851. We decided to check our estimate of the number of cotton workers, based on the *UDB* sample, against industry-based estimates for 1801. Note that in the following calculations we use the same methods that underlie the Mitchell estimates and also exactly the same historical sources. The main difference lies in the fact that our calculation is more complete, including types of workers that he ignores.

Mitchell cites four historical sources and takes his headline numbers from Wood.⁹³ However, all the usable underlying data come from Ellison and Baines (most of Wood's analysis is based on Ellison whilst Porter reproduces Baines, often verbatim). Baines himself relies heavily on a certain Mr. Kennedy, who is a *prima facie* reliable source because he lived through the spinning revolution of the late eighteenth and early nineteenth centuries and seems to have been personally acquainted with some of the protagonists, such as Arkwright. The basic method of estimating the number of cotton workers is the following. First, take the quantity of retained raw cotton imports, which is recorded in the trade returns. Second, multiply this by 14.5/16 to reflect wastage in the production process; this gives the total amount of cotton output (both the intermediate output – yarn – and the final output – cloth), measured in avoirdupois pounds. Third, divide this weight of yarn by the annual weight that could be spun by one cotton spinner (i.e. output per worker) to infer the number of cotton spinners. Fourth, divide this weight of cotton cloth by the output of one cotton weaver to infer the number of weavers.

Baines (citing Kennedy) makes this calculation for 1817 and 1832.⁹⁴ We reproduce his figures in the first two rows of table 7 below. Data on cotton thread spun per worker in 1832 and 1817 are based on observations of a sample of factories (for 1817, we are not told how many factories or workers are included in the sample; for 1832, the sample covers thousands of workers from numerous mills in Manchester). Note that the estimated number of workers includes everyone working in cotton spinning factories (women, children, helpers and so on), not just men who would have identified themselves as “spinners”. We do not know the amount of cotton thread spun per worker in 1801 and we must estimate it. How? Using the method explained in Ellison.⁹⁵ Take the difference between the price of the raw cotton input and the revenue from selling the resulting cotton yarn output. This is the return to labor and capital. Calculate the percentage change in this margin. This is a crude measure of the change in labor productivity (crude because it conflates changes in the return to labor with changes in the return to capital). This is analogous to the dual method of productivity measurement. How large are the estimation errors based on this approximation? It appears that they are very small. Direct measurement of the change in labor productivity between 1817 and 1832 suggests that it rose by a factor of 1.89 (=1702/900). Indirect measurement from dividing net revenues suggests that labor productivity rose by a factor of 1.88 (=7.5/4).

⁹³ Wood, “Statistics of wages”, 598; Baines, *History*; Ellison, *Cotton*; Porter, *Progress*.

⁹⁴ Baines, *History*, 369-78.

⁹⁵ Ellison, *Cotton*, 55.

Now implement the Ellison method for measuring the change in labor productivity between 1830 and 1799, and between 1812 and 1799. The data that he supplies (as reported in table 7 below) imply that labor productivity rose by a factor of 7.41 over the longer period (31 years) and a factor of 4.17 for the shorter period (13 years). Suppose that it rose similarly for the 31-year period from 1801 to 1832; or the 16-year period from 1801 to 1817. Then this generates the estimates of 1801 output per worker of 230 and 216 pounds of yarn per annum respectively (as reported in column 2 of table 7). Note that the latter figure is an overestimate of the level of productivity in 1801 because we are taking a productivity change measured over 13 years and working back to benchmark 16 years earlier. If we reflat the productivity change by 16/13 to adjust for this fact then we get an estimated output per worker of just 176 pounds of yarn per annum in 1801. These generate estimates of the workforce engaged in cotton spinning of 213 496, 227 162 and 279 585 people respectively (as reported in column 3 of table 7).

Table 7. Estimates of the workforce engaged in cotton spinning.

	Cotton thread spun per worker (lbs/annum)	Estimated workers in cotton spinning	Retained cotton wool imports	Price of 1 lb of 40-hank cotton yarn (d)	Price of cotton wool required to produce 1 lb of 40-hank cotton yarn (d)	Implied cost of labour and capital in yarn production (d/lb)
1832	1702.4370	133 045	249933370	11.25	7.25	4.00
1817	900.0072	110 763	110000000	30.00	22.50	7.50
1801	229.8290	213 496	54143433			
1801	216.0017	227 162	54143433			
1801	175.5014	279 585	54143433			
1830				14.50	7.75	6.75
1812				30.00	18.00	12.00
1799				90.00	40.00	50.00

Sources and notes. Baines, *History*, 347, 369-78; Ellison, *Cotton*, 61.

All of our estimates are far higher than the figure of 95 000 reported for 1806 by Mitchell. This is simply a function of the rapid increase in labor productivity in the intervening five years: the faster is the estimated productivity growth, the higher is the implied number of workers required to spin the cotton in earlier years. If we want to maintain that there were fewer spinners in 1801 then we must revise upwards their productivity. Ellison postulates that there were 60 000 factory spinners in 1787, based on a (now lost) document prepared by an association of Manchester cotton spinners. But the trade data show that there were 22 177 000 pounds of cotton wool spun. In 1815 Ellison postulates that there were 100 000 spinners processing 92 526 000 pounds of cotton wool. This implies that labor productivity in spinning rose by a factor of exactly 2.5 between 1787 and 1815. But this seems implausibly low. In 1787 there were many hand spinners, and machine spinners were operating relatively few spindles (maybe 20 per person). By 1815, each machine spinner was operating perhaps 300 spindles.⁹⁶ The increase in labor productivity that we postulate in table

⁹⁶ Baines, *History*, 201-7.

7 above – somewhere between a four-fold and six-fold increase – is surely more consistent with the known technological improvements than is an increase of merely two-fold.

Now let us consider the number of weavers. We know how much cotton cloth they were weaving but we do not have good information on output per weaver. In 1801 virtually everything was woven by hand. But, from that time onwards, increasing amounts were woven on power-looms. So the later data are contaminated by the mixture of hand weaving and machine weaving. Baines offers us the data reported in table 8 below. This translates directly into a pair of simultaneous equations with two unknowns (output per hand-loom weaver and output per power-loom weaver). Solving this implies that each hand-loom weaver produced 281.9487 pounds of cloth per annum, and each power-loom weaver 1 795.231 pounds. This in turn implies that, if all the cotton yarn in England were woven into cloth by hand in 1801, then there were 174 030 cotton weavers.

Table 8. Estimates of the number of hand-loom and power-loom weavers.

	No. of power-loom weavers	No. of hand-loom weavers	Yarn woven into cotton cloth in England (lbs/annum)
1819-21	10 000	240 000	85 620 000
1829-31	50 000	225 000	153 200 000

Sources and notes. Ellison, *Cotton*, 59, 66.

These calculations suggest that there were 213 000 cotton spinners and 174 000 cotton weavers in 1801, giving a total for cotton manufacturing of 387 000 workers. This excludes printing, dyeing, bleaching, embroidery and other such occupations. This makes the estimate of 240 000 workers (“Cotton manufacture”, “Fustian manufacture” and “Thread manufacture”) from our synthetic census look rather low, and Mitchell’s estimate of 274 000 similarly low. This is important because our sectoral analysis in section 10 will demonstrate only a modest increase in employment in the cotton industry, and a declining employment share, which may seem surprising given the perceived importance of cotton in the industrial revolution. Revising upwards the estimated employment in the cotton industry in 1801 (away from the synthetic census and more in line with the figures produced in the alternative analysis presented above) would generate an absolute decline in employment, as well as a relative decline. Of course, the cotton industry was remarkable for its rate of technological change, its effect on business organization and its social impact. So our discovery of a decline in the employment share is remains consistent with its prominence in the historiography of industrialization.

9. National occupational structure in 1801. It is difficult to summarize an employment distribution with 369 occupations in a meaningful and informative way. Of course, we are not the first researchers to struggle with the problem of aggregating occupational data in such a way that the volume of information is small enough to comprehend but sufficiently detailed to be useful.⁹⁷ As a first pass, let us look at the data using the primary-secondary-tertiary (PST) system. This has the advantage of facilitating comparisons with other research, which is typically presented in the PST format.

In table 9 below we present our results alongside those of Crafts and Kitson *et al.*. The Crafts data have been used repeatedly over the last 25 years as a basis for estimating

⁹⁷ Wrigley, “PST system”.

economic growth; the Kitson *et al.* results are very recent and have been causing people to rethink the pace of industrialization. Our PST distribution is very close to that proposed by Crafts. We have somewhat fewer workers in agriculture, and correspondingly higher shares in industry and services, but the difference is very small. By contrast, the Kitson *et al.* data show a much higher share of industrial workers already by 1817, and a much lower share of service workers. An important caveat – as Kitson *et al.* state very clearly in their numerous papers – is that their data pertain to males only.⁹⁸ Hence their estimates are not strictly directly comparable to the other estimates in table 9; we say much more about this below.

Table 9. Comparison of estimates of occupational structure.

	<i>1800</i> <i>(Crafts)</i>	<i>1801</i> <i>(Brunt-Meidell)</i>	<i>1817</i> <i>(Kitson et al.)</i>	<i>1851</i> <i>(Census)</i>
Primary	40	38	38	28
Secondary	30	31	42	41
Tertiary	30	31	19	32

Sources: 1800 – Crafts, *British industrialization*, 62; 1801 – see text; 1817 – Kitson *et al.*, “Occupational structure”, 10. Note that the data provided by Kitson *et al.* pertain only to male employment and are therefore not directly comparable with the other data. We present them here because other researchers have concluded – on the basis of these figures – that the shift into industry of total labor resources (i.e. male and female) occurred much earlier than previously thought.

The recent research of Kitson *et al.* seems to paint a very different picture of the rate of industrialization to that proposed by Crafts (and, later, Crafts and Harley).⁹⁹ Kitson *et al.* find very little trace of industrialization in the early nineteenth century. Instead they find a Commercial Revolution, with a dramatic relative shift of employment out of agriculture and into services. By contrast, we seem to find no significant increase in the service sector share but very strong growth in industry. But closer inspection changes this picture somewhat and helps to partially reconcile the two estimates.

First, note that Britain was at war in 1801 and at peace in 1817 and 1851. Thus the military accounted for 3.5 per cent of the working population in 1801, compared to 1.2 per cent in 1817 and 0.7 per cent 1851. The military is (perhaps surprisingly) part of the service sector and it is interesting to see what our occupational structure might look like if there had been peace in 1801. We subtracted 2.3 percentage points from military employment and redistributed it across all the other occupations in proportion to their size. This exercise generates the results in column 4 of table 10 below. We now show a three percentage point increase in the employment share of the service sector between 1801 and 1851, an agricultural employment share almost identical to Crafts and Kitson *et al.*, and still a marked growth in industrial employment.

Table 10. Comparison of adjusted estimates of occupational structure.

1	2	3	4	5	6	7
	<i>1800</i> <i>(Crafts)</i>	<i>1801</i> <i>(Brunt-Meidell)</i>	<i>1801</i> <i>(adjusted</i> <i>Brunt-Meidell)</i>	<i>1817</i> <i>(adjusted</i> <i>Kitson et al.)</i>	<i>1817</i> <i>(Kitson et al.)</i>	<i>1851</i> <i>(Census)</i>
Primary	40	38	39	34	39	28
Secondary	30	31	32	37	42	41

⁹⁸ Kitson *et al.*, “Creation of a ‘census’”.

⁹⁹ Crafts and Harley, “Output growth”.

Tertiary	30	31	29	29	19	32
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Sources: as table 6 and described in the text.

Second, how can we explain the apparent decline in industrial employment between 1817 and 1851? Kitson *et al.* offer estimates of male employment only. The danger is that other researchers might take this to be representative of both male and female employment. How much difference might it make if we incorporated females into the analysis, and thus made it comparable to our analysis? The 1851 census reveals that 35 per cent of the working population was female.¹⁰⁰ Suppose that this were also true in 1817, and that the female PST breakdown in that year were 25 per cent, 29 percent and 46 per cent respectively. This would generate column 5 of table 10 above and Kitson *et al.*'s PST distribution would look much more similar to our own. Is the female PST breakdown that we postulate for 1817 plausible? In 1851 the female breakdown was 15 per cent, 39 percent and 46 per cent respectively. Most of the female workforce in the tertiary sector in 1851 was in domestic service (25/46 per cent); it seems plausible that the relative importance of this element was fairly static over time, and hence any change in the share of service sector employment for females was likely to have been dampened. So the issue really comes down to whether we believe that there was a large shift of female employment out of agriculture and into industry – a shift equal in size to that which we see for males. Such a shift seems entirely possible, especially given the prominent role of women in factory production (for example, there were more women than men employed in cotton manufacture) and the mechanization of agricultural tasks in which women specialized (harvesting).

Third, is it possible to further close the gap between our estimates and those of Kitson *et al.*? Their procedure is similar to ours in the following sense. They take the population of baptismal registers and treat them as a sample of observations on the occupation of the father; we take the population of business entries (in trade directories covering a large set of towns) and treat them as a sample of businesses operating in those towns. They do not pretend that their observations (of fathers) cover the entire population of their towns; clearly they do not, since many men would not have had children in the period of their study (1813-20). Similarly, we do not pretend that our observations (of businesses) cover the entire population of businesses. In both cases, we are drawing a sample that we believe reveals the *distribution* of people across occupations, not the absolute number of people in each occupation. Brunt and Meidell consider in detail what conditions must be met in order for our inferences about the distribution to be valid; they also consider what conditions Kitson *et al.* require for their inferences to be valid. There is a crucial assumption that we want to consider here in some detail. It must be the case that male completed fertility (that is, the total number of children produced per man) was the same for men across all occupations. It is this assumption by Kitson *et al.* that we find to be most problematic.

If the assumption of equal fertility across occupations is just slightly violated then it has a large impact on the estimated occupational structure. Suppose that we sample four baptismal records and find that two fathers are recorded as agriculturalists and two as industrial workers. Kitson *et al.* then infer that there were two agricultural workers and two industrial workers in the workforce (an industrial share of 50 per cent). Now suppose that

¹⁰⁰ The main categories of non-working female are “Wife (of no stated occupation)”, “Widow (of no stated occupation)”, “Daughter, granddaughter, niece, etc. (not otherwise enumerated)” and “Scholar – under tuition at school or college”. This constitutes the majority of females in the population.

each agricultural worker had one child and each industrial worker had two children in their lifetime. Then, of course, there would really be two agriculturalists but only one industrial worker in the workforce (an industrial share of 33 per cent). As we sketch in table 11 below, small variations in completed fertility across occupations could change Kitson *et al.*'s estimates of occupational structure into our estimates. Kitson *et al.* observe the data in column 2 and assume a one-to-one mapping to the number of fathers, thus generating column 3 and therefore column 4. Now suppose instead that the completed fertility of agricultural families were 15 per cent lower than average, and the completed fertility of industrial families 15 per cent higher, as inscribed in column 5. Then the observations in column 2 map instead to the number of fathers in column 6, and then on to the occupational structure of column 7. But columns 4 and 7 below are simply columns 5 and 4, from Table 10 above, restated. Thus the remaining differences between Kitson *et al.* and ourselves, regarding the estimated occupational structure, have entirely vanished.

Table 11. Possible effect of variations in occupational fertility.

1	2	3	4	5	6	7
	<i>Observed Baptisms</i>	<i>Inferred Number of Men (Kitson et al.)</i>	<i>Inferred Occupational Structure (Kitson et al.)</i>	<i>Hypothesized Occupation-Specific Fertility</i>	<i>Inferred Number of Men</i>	<i>Inferred Occupational Structure (Brunt-Meidell)</i>
Primary	1.15	1.15	34	0.85	1.35	39
Secondary	1.25	1.25	37	1.15	1.10	32
Tertiary	1.00	1.00	29	1	1.00	29

Sources: see text.

Overall, we do not find any glaring inconsistencies between our data and those of Kitson *et al.*. Adjusting our data for the effect of the Napoleonic Wars, and plausibly adjusting their data for the absence of women and differential fertility across occupations, reveals two estimates of occupational structure that are very similar. Since the two estimates anyway pertain to benchmark years that are 16 years apart, we certainly could not say that the two estimates are significantly different. We stress that we believe that our *unadjusted* estimates are accurate for 1801: the Napoleonic Wars were pushing up measured employment in the service sector to extraordinary heights at that time and the occupational distribution of the workforce was as we have reported it here. But this is perfectly consistent significant growth in the commercial (i.e. non-military) part the service sector between 1801 and 1851. Our estimates are also consistent with those of Crafts. We find slightly fewer workers in agriculture in 1801 and marginally more in industry and services: so the structural transformation was slightly slower than previously thought, but not very much.

Finally, it is important to consider the effect of likely biases on the estimated values of industrial employment. The primary weakness of our approach is that we are taking data on the number of employees per establishment in 1851 and applying it to 1801. It is plausible that establishment size increased over the period. For example, cotton factories and ironworks may well have become larger. This will lead us to *overestimate* the number of workers in those industries in 1801 because we will be multiplying our sample of cotton and iron businesses in 1801 by a factor that is too large. Thus it is possible that our estimate of industrial employment in 1801 is too high and it is reasonable to regard it as an upper bound. This means that any refinements to our technique would move our estimate further away from Kitson *et al.* and make industrialization more rapid.

By contrast, consider the primary weaknesses of Kitson *et al.*'s approach. First, they exclude women from their analysis: since the excluded women were disproportionately engaged in the service sector, this biases upwards the apparent importance of industry in total employment. Second, they quite possibly over-weight industrial fathers: these fathers plausibly had higher completed fertility, and therefore have been counted more times in the baptismal registers. Thus it is reasonable to regard the Kitson *et al.* estimate of industrial employment as an upper bound also. But our upper bound on industrial employment is already lower than theirs, so our data give a "tighter" characterization of employment in the English economy in the early nineteenth century. Refining their technique by incorporating women and differential fertility would simply move their estimate of the share of industry closer to ours, again revealing more rapid industrialization.

10. The change in occupational structure between 1801 and 1851. Going beyond PST offers important insights into the process of industrialization. The 17 census classes are too broad for meaningful analysis. For example, Class XII ("Products of the animal kingdom") covers everything from cowkeepers to whalebone makers to wool weavers to tanners; so describing what happens to this class as a whole would not be very informative. Yet individual occupations are really too numerous to be intellectually manageable. Hence we work on the basis of the 90 census sub-classes. These are fairly cohesive and correspond to what we might think of as industries – such as "Skins", "Wool", "Silk" and so on.

In table 12 below we list the biggest losers, in terms of their share in total employment. That is, we take the share of each sub-class in total employment 1851; we subtract its share in total employment in 1801; and we are left with the change in the employment share. For example, the employment share of agriculture declined by 12 percentage points, from 35 per cent of total employment in 1801 to 23 per cent in 1851.¹⁰¹ We (somewhat arbitrarily) report the data for all industries whose employment share changed by more than one percentage point. Of course, some sectors had a much larger employment share at the outset. So the sector with the biggest change in employment share is not necessarily the one with the biggest absolute change in employment because it might have started with a relatively small share in 1801. This means that two sectors can have the same change in employment share (such as the linen and woolen industries) but very different changes in absolute employment; they are starting from a different base. Thus, in order to gauge the overall economic impact, we also report the absolute change in employment between 1801 and 1851. We still believe that employment *shares* are of interest, however, because the industrial revolution has come to be defined as a change in employment shares, not just an increase in absolute numbers. Note that the population roughly doubled over this period. So it is possible for market share to decline dramatically but absolute employment rise at the same time (just not as fast as other sectors); this is the case with agriculture. In fact, it is quite unusual to find an absolute decline in employment because there are very few sectors that experience such a precipitous drop in their employment share.

Table 12. The biggest losers, in terms of their share in total employment, 1801-51.

<i>Industry</i>	<i>Change in share</i>	<i>Change in employment</i>
Agriculture	-12.0%	-423 749

¹⁰¹ The employment share of the *primary sector* was 39 per cent – as revealed in table 10 – but this includes fishing and mining, as well as agriculture.

Woolen industry	-3.1%	-2 048
Linen industry	-3.0%	-119 075
Military	-2.7%	-87 318
Mechanic, manufacturer, shopman, shopwoman	-2.4%	-96 161
Merchant seaman	-1.7%	-25 272
Inland navigation	-1.1%	-28 264

Source: see text.

The declining share of agriculture is well known. The declining share of the woolen and linen industries is also known from qualitative sources, although here we are able to quantify its relative and absolute importance for the first time. Interestingly, there was also a relative decline in employment in the cotton industry (-0.8 percentage points), although absolute employment rose by 216 816. This is obviously rather surprising – given the prominence assigned to the cotton industry in the traditional historiography – but we have considered the data on cotton employment in detail in section 8 above and need say no more about it here. The decline in employment in inland navigation can be explained by the advent of railways. The decline in employment of merchant seamen is due to the change in trade patterns: a redistribution of seamen from the coastal trade to long distance voyages was reflected in the census as a decline in the number of merchant seamen in the population. The category of “Mechanic, manufacturer, shopman, shopwoman” may simply reflect a lower quality of information recording in the *UBD*, since this is a rather disparate and opaque category, so does not bear the weight of any particular interpretation. The really striking contribution comes from the British Army and the Royal Navy. A massive 2.7 per cent of the working population was demobilized between 1801 and 1851 (all prime age males) and this offered one of the few examples of actual “labor release” (i.e. a physical reallocation of existing workers to other sectors). As far as we are aware, this effect has never before been emphasized in the existing literature on British industrialization.

The list of winning sectors is rather more surprising than the list of losers, as reported in table 13 below. Top of the list is apparel. This may reveal a genuine shift in output and consumption, or it may simply reflect the marketization of a sector that was previously based on home production. There was also a marked increase in the importance of construction and the aggregates industry (that is, stone, sand, bricks and other mineral products used in construction). The absolute change in employment in these sectors was also large. By contrast, the increase in the iron industry was a modest 2.3 per cent of total employment. Given the prominence of the iron industry in the historiography of the industrial revolution, such a small increase in employment is very surprising. Of course, the increase in iron *output* and *productivity* may still have been exceptional – our data do not speak to those issues and we simply note that employment growth was not spectacular. The coal industry does not even make the cut, gaining 140 493 workers and a rise in employment share of 0.7 percentage points. Several other industries show significant increases in their employment share (alcohol, grain and meat; silk); that is, they were growing much faster than was warranted simply by the expansion in the population (in which case their share would have been constant). Note that employees in these “industries” would not all be categorized as industrial workers. For example, maltsters and brewers are in the industrial sector but innkeepers and beershopkeepers are in the service sector. Two other service sector categories, “General merchants” and “Messengers and porters”, also narrowly missed the cut, gaining nearly 1 percentage point each and accumulating an additional 218 000 workers between them.

Table 13. The biggest winners, in terms of their share in total employment, 1801-51.

<i>Industry</i>	<i>Change in share</i>	<i>Change in employment</i>
Apparel	6.0%	789 281
Construction	3.3%	335 175
Aggregates industry	1.1%	102 227
Iron industry	2.3%	240 678
Alcohol industry	1.4%	153 203
Meat industry	1.3%	117 301
Grain industry	1.2%	115 136
Silk industry	1.3%	123 787
Other non-agricultural, non-government	9.3%	1 915 169

Source: see text.

We would argue the most interesting group is the one that we term “Other non-agricultural, non-government”, whose share in total employment grew by 9.3 percentage points and which added 1.9 million workers. This group comprises 62 sub-classes covering myriad trades. Within this group, 47 sub-classes see a rise in their *share* in employment and only 6 sub-classes see a decline. How is this numerically possible? The decline in the employment shares of agriculture, wool, linen and the military was sufficiently large that virtually all other industries could increase their share. And – most importantly – virtually all of them *did* increase their share. And their combined effect, in terms of numbers employed, was an order of magnitude larger than the impact of the cotton or iron industries. For this reason, we say that British industrialization was broad. It may be the case that productivity and output growth were concentrated in cotton and iron, as Crafts and Harley argue; this paper has nothing to say about output or productivity. But Crafts and Harley define industrialization as a shift of labor resources into industry. If we accept their definition then British industrialization was very broad and – to the extent that there were any “leading sectors” – they were apparel, construction and food and beverages. Thus we find that the employment data are more consistent with Temin’s view of broad-based industrialization.

11. Conclusions. It is possible to infer the occupational structure of the employed population from trade directories. We tested the method for 1851 (a year for which we have both trade directories and an occupational census); and we applied the method to 1801 (a year for which we have trade directories but no occupational census). This permitted us to construct a synthetic occupational census for 1801 and trace changes in occupational structure over time. Most importantly, since we are working from data on businesses we are implicitly including laborers and females in the workforce. This removes two important sources of bias that plague studies based on sampling individuals’ occupations, such as baptismal records or militia ballots, where laborers and women are typically either underrepresented or entirely absent.

We find a significant increase in the share of industrial employment between 1801 and 1851, up from 31 to 41 per cent. This is similar to the increase postulated by Crafts and Harley, based on the very imperfect data provided by Massie. But it is significantly larger than the three percentage point increase in industrial employment found recently (for males only) by Kitson *et al.*.

The industrial increase was exactly matched by the fall in the agricultural share from 38 to 28 per cent. There was also a very slight increase in the service sector from 31 to 32 per cent. Service sector employment was inflated in 1801 by military mobilization, which accounted for 3.5 per cent of total employment. A counterfactual supposing that military

enrolment was only 1.2 per cent of total employment (as in 1817) suggests that industrial employment over the period would have risen from 32 to 41 per cent; services would have risen from 29 to 32 per cent; and agriculture would have fallen from 39 to 28 per cent. This increase in industrial employment is only marginally slower than that supposed by Crafts and Harley. Overall, the new employment data provide no motivation to revise substantially the existing estimates of economic growth, nor our understanding of the underlying mechanisms that drove them.

One aspect of industrialization that may need to be revised is its industrial concentration. We offer no comment on output or productivity growth but we can say that employment growth in cotton and iron was modest. Employment growth in other sectors was much more quantitatively important (apparel, construction, food and beverages). Most interestingly, there were small contributions from virtually all sectors, showing that industrialization was very broad. This lends support to Temin's analysis of trade data, where he finds that England increased its exports in a wide range of industries.

Appendix 1. Estimating the urban population of England in 1801. In order to draw a sample of urban occupations that is representative of the national urban population, we need to control for the marked occupational variation across England. This variation is determined partly by geography – for example, there was a lot more woollen cloth production in Yorkshire, where high rainfall generates sheep production and sheep production generates wool. But the variation was also determined partly by town size – larger towns accumulate different functions to smaller towns and this is reflected in the make-up of the local workforce. Therefore, as a first step to drawing a representative sample we need to quantify the distribution of towns by size and region. This is the issue that we address in this appendix.

Several researchers have compiled data on the urban population of England around 1800. Notably, De Vries compiled population estimates at benchmark dates (including 1800) for all European cities having a population larger than 10 000 people at some point in the period 1500 to 1800.¹⁰² And Bairoch *et al.* compiled population estimates at benchmark dates (including 1800) for all European cities having a population larger than 5 000 people at some point in the period 800 to 1850.¹⁰³ Finally, Clark and Hosking compiled population estimates at benchmark dates (including 1811) for all English towns having a population *smaller* than 5 000 people at some point in the period 1550 to 1851.¹⁰⁴ Bringing together these three sources should logically give us full coverage of English urban areas in 1800. In fact, in many cases we will have two or three estimates of the population of a particular town or city and we started with a comparison of the three sources in order to gauge their consistency.

A comparison of the English urban population estimates of De Vries and Bairoch *et al.* reveals that they are almost identical. This is not very surprising because Bairoch *et al.* use De Vries as one of their sources. Given that Bairoch *et al.* offer a wider coverage which – most importantly – overlaps with that of Clark and Hosking, we rely hereafter on Bairoch *et al.* for population estimates for the larger cities.

Clark and Hosking compiled a list of 802 English small towns spread across all English counties. Their criteria for inclusion in the list comprised not only the population size of the town but also its economic function. For example, if coach timetables revealed that a particular town was an important transport node then it might be included, even though it had only a few hundred people living there. In fact, the town with the smallest population in their

¹⁰² De Vries, *European urbanization*. Note that cities with a population larger than 10 000 *at some point* spent much of their history with a population smaller than 10 000. Wherever possible, De Vries noted the population of every city in his data base at every benchmark date, so many of his data points are of populations smaller than 10 000.

¹⁰³ Bairoch *et al.*, *Population*. Note that cities with a population larger than 5 000 *at some point* spent much of their history with a population smaller than 5 000. Wherever possible, Bairoch *et al.* noted the population of every city in their data base at every benchmark date, so some of their data points are of populations smaller than 5 000.

¹⁰⁴ Clark and Hosking, *Population*. They prefer the 1811 census to the 1801 census because the former is generally thought to have been significantly more accurate; the 1801 census was the first of its kind in England and was therefore quite rough-and-ready (a casual inspection of the occupational data, in particular, reveals that are worthless because most people's occupations were not recorded). Although there was population growth between 1811 and 1801, the size distribution of towns probably did not change significantly; almost certainly, any error induced by the 1801/1811 temporal mismatch is less than the error that would be induced by switching our analysis to the 1801 town census data. Note that towns with a population smaller than 5 000 *at some point* spent some of their history with a population larger than 5 000. Wherever possible, Clark and Hosking noted the population of every town in their data base at every benchmark date, so some of their data points are of populations larger than 5 000.

list is Setchley in Norfolk, with only 88 people. Their criteria are designed to reflect the perspective of geographers as well as economists. Geographers are interested in the functions of towns as well as their sizes and they commonly classify towns on the basis of a hierarchy. For example, each county will typically have a single administrative center (the county town) and below this might lie several exchange centers (towns with grain markets) and below this might lie a larger number of transport centers (coaching hubs) and so on. This is relevant to our examination of occupational structure because it could mean that focusing only on large towns would systematically skew the observed distribution of occupations (for example, towards administrative personnel and away from transportation personnel). How large is the possible bias? Around 43 per cent of the urban population were living in towns smaller than 5 000 people (as we discuss in more detail below). Moreover, virtually no occupation comprised more than a few per cent of the urban workforce. So, if the 43 per cent of the urban population residing in small towns were concentrated in a small number of occupations, then excluding them from our analysis could lead to relatively large biases in our observed occupational structure.

The immediate challenge is then to combine the Bairoch *et al.* data and the Clark and Hosking data into a single distribution that reflects as accurately as possible the true size and geographical distribution of English towns. An important question is whether the data of Bairoch *et al.* and those of Clark and Hosking are consistent with one another; if not, then it would be hazardous to use the two sources to try to generate one continuous distribution. The 802 town populations reported by Clark and Hosking and the 151 reported by Bairoch *et al.* contain an overlap of 42 towns. Regressing the Bairoch *et al.* data on the Clark and Hosking data (purely as a descriptive statistic) gives the model reported in the column 2 of table A1 below. As we would hope to see, the constant is not significantly different from zero and the coefficient on the Clark and Hosking data series is unity (i.e. population differentials across towns in the Bairoch *et al.* data set are exactly matched by population differentials in the Clark and Hosking data set). Consistent with this, the average population of the sample according to the Bairoch *et al.* data is 9 595 and according to the Clark and Hosking data it is 9 441.

Table A1. Matching town population samples.

Dependent variable: Bairoch et al. 1801 population	Model of matched observed towns	Model of matched estimated towns
Constant	355.58 (885.26)	-1998.26 (1578.94)
Clark and Hosking 1811 population	1.01** (0.08)	2.39** (0.26)
r-squared	0.80	0.64
N	42	50

Notes. Standard errors in parentheses. * denotes statistically significant difference from zero at the five per cent level; ** denotes statistically significant difference from zero at the one per cent level.

Unfortunately, the story rapidly becomes more complicated from here on. The enumeration of the census in England and Wales was carried out at the level of the parish. Local enumerators were drawn from parish officers (such as the administrators of the Poor Law) and they were tasked with visiting each habitation in their parish to count the number of occupants. The office of the Registrar General of England and Wales then published the census returns at the level of the parish, ensuring that these data are readily available and quite

accurate. Unfortunately, towns and parishes are rarely coterminous. Large towns and cities are commonly composed of several (sometimes many) parishes; the populations of these parishes can be summed to give a fairly accurate estimate of the population of the town. The situation is more problematic for small towns, where the urban population might constitute only a modest percentage of the population of the parish. More worryingly, the scale of this problem varies substantially across England and Wales. For example, when the parish boundaries were set down in Lancashire, it was a sparsely populated county and the parishes were made correspondingly large (in order to ensure a reasonable number of occupants of each parish). But the county was much more densely populated by 1801 because it was at the geographical heart of the Industrial Revolution; this means that parish populations are a particularly poor guide to town sizes in Lancashire.

Clark and Hosking report the sum total population of all the parishes that comprised each of the 802 towns in their data set, since those data are readily available and based on a consistent definition across space and through time. In addition, they report the population of each town wherever this information is available (for example, as a result of a particular local survey or government enquiry). Such data are available for 267 towns in their data set. It is from this set of 267 towns that we drew the sample of 42 towns that overlapped with the Bairoch *et al.* data and ran the regression reported in the middle column of table A1 above.¹⁰⁵ The problem is how we should treat the other 532 towns in the Clark and Hosking data set, for which we have only the parish population totals. We need to somehow combine these data with the town populations in the Bairoch *et al.* data in order to generate a single, continuous distribution of town sizes.

We could try to estimate this size distribution of English towns in two parts. That is, we could estimate upper part of the distribution based on the (left-hand-truncated) Bairoch *et al.* data; and we could estimate the lower part on the (right-hand-truncated) Clark and Hosking data. We could then adjust the parameters of the two estimated distributions such that they matched at the overlap. Unfortunately, this is not a very practical approach because the size distribution is highly skewed: the smallest town (Setchley in Norfolk) had a population of 88, the largest town outside London (Manchester in Lancashire) had a population of 84 000, the median was 8 000, the mean was 3 069, and the mode was just 1 448. When estimating the distribution using the Bairoch *et al.* data, we would be trying to estimate the whole distribution using only the long right hand tail and this would give very inaccurate results.

We therefore proceed using a simpler but more effective approach. Taking the 270 towns for which Clark and Hosking report both the town population and the parish population, we estimate a model of the natural logarithm of town population using the natural logarithm of parish population and county dummies.¹⁰⁶ This is reported in table A2 below. It will be seen that the model offers quite a good fit of the data, with most of the variation being successfully explained.

¹⁰⁵ Clark and Hosking report the town and parish populations for Burnley, Clitheroe, Colne and Haslingden in Lancashire. These form a group of contiguous towns that are all located in the same parish. This is a rather unusual situation that added a lot of noise when estimating the relationship between urban population and parish population, since they all had the same parish population but different town populations. We therefore created a town called Burnley-Clitheroe-Colne-Haslingden for the purpose of running our regression.

¹⁰⁶ We experimented with both simpler and more sophisticated models – running the regression not in logarithms, interacting the county dummies with parish population, adding squared terms and so on. They all gave essentially the same results as those reported here but none of them were as parsimonious.

Table A2. Estimating town populations based on parish populations.

	Coefficient	Standard error
Constant	0.0477463**	0.373989
ln(1811 parish population)	0.8865743	0.0400032
Bedfordshire	0.3132085	0.3885125
Berkshire	0.3526716	0.2770319
Buckinghamshire	0.338294	0.3299569
Cambridgeshire	0.5131802	0.5214323
Cheshire	-0.0425994	0.2063466
Cornwall	0.1592858	0.2189035
Cumberland	0.4799763*	0.2277661
Derbyshire	0.0815524	0.2181321
Devonshire	0.5063894	0.3871044
Dorsetshire	0.5166454	0.3319652
Durham	-0.4102043	0.2334695
Essex	0.3264209	0.2976283
Gloucestershire	0.1027199	0.2625565
Hampshire	0.3802947	0.3297822
Herefordshire	0.4963112	0.3300077
Hertfordshire	0.2786098	0.3299306
Kent	0.6602916*	0.2760358
Lancashire	-0.2963461	0.1924041
Leicestershire	0.442694	0.240819
Lincolnshire	0.605441**	0.2171947
Norfolk	0.2802425	0.3332217
Northamptonshire	0.7369621*	0.3307358
Nottinghamshire	-0.6177764	0.5216855
Oxfordshire	0.5925332*	0.2420641
Shropshire	0.1158797	0.2500276
Somersetshire	0.6708403	0.5227441
Staffordshire	0.2642464	0.2611915
Suffolk	0.4367808	0.3321678
Surrey	-0.8393632*	0.3868462
Warwickshire	0.4595105	0.298302
Westmorland	0.0075921	0.261281
Wiltshire	-0.0392502	0.2611217
Worcestershire	0.4814072	0.2976019
Yorkshire (East Riding)	0.5713766*	0.2767489
Yorkshire (North Riding)	0.328767	0.2148402
Yorkshire (West Riding)	-0.0816294	0.1862092
r-squared	0.73	
N	265	

Notes. Some counties (Huntingdonshire, Middlesex, Monmouthshire, Northumberland, Rutlandshire and Sussex) had too few observations to estimate the coefficient on the county dummy and these dummies were therefore dropped from the regression. * denotes statistically significant difference from zero at the five per cent level; ** denotes statistically significant difference from zero at the one per cent level.

Using the model reported in table A2, we estimated the town populations for the 532 towns in the Clark and Hosking sample for which we had only the parish population. In order to check the plausibility of our results, we took these estimated population totals and looked at the 50 towns with which there was an overlap with the Bairoch *et al.* data set. Again, we ran a regression purely as a descriptive statistic and this is reported in column 3 of table A1 above. We were expecting to find again a coefficient of unity and were rather worried to find a

coefficient of 2.39. This is reflected in the fact that the average population of the sample according to the Bairoch *et al.* data is 9 061 and according to the Clark and Hosking data it is 4 564. At first sight, this suggested that our model was underestimating the urban population of each parish. But a more interesting story emerges when we look at the parish populations. In the sample of 42 towns for which both Bairoch *et al.* and Clark and Hosking give us the urban populations, the average parish population is 25 380 and the average town size 9 595 (according to Bairoch *et al.*). But for the second sample – the 50 estimated town populations based on the parish populations reported by Clark and Hosking – the average parish population is just 9 819 and the average town size still 9 061 (according to Bairoch *et al.*). Given the small size of the parish populations, it is no wonder that our model estimates such modest urban populations of only 4 564 (on average). The fact that the urban populations proposed by Bairoch *et al.* imply that virtually the entirety of each parish was urbanized (and that this is at odds with what we know about the other towns in their sample) casts serious doubt on their estimates.

How can we explain this discrepancy? Given that the correlation between the parish population and urban population for this sub-sample of the Bairoch *et al.* data is close to unity, we suggest that they have simply taken the parish population and ascribed it all to the town. In many cases, such a procedure is not problematic. In particular, large towns tend to be densely populated and expand to fill their entire parish (or several parishes), so assuming that the town population equals the parish population is probably close to the truth. Since they are mostly interested in larger towns, it is probably justifiable to assume that the town population equals the parish population. But for smaller towns this would not be true. It is therefore highly plausible that the true town sizes were closer to the 4 564 that we estimate (on average) than the 9 061 that Bairoch *et al.* estimate (on average).

In the light of this analysis, whenever possible we take the town populations reported by Clark and Hosking or the town populations estimated on the basis of our model and the Clark and Hosking parish populations. When neither of these is available, we take the Bairoch *et al.* population; when this is not available, we take the parish populations for 1811, as reported in the 1831 census.¹⁰⁷ Again, we stress that this is unlikely to lead to any substantial error because we take the Bairoch *et al.* populations mostly for the larger towns and their estimates are probably fairly accurate for such towns. There are only two exceptions to this rule. We take the Bairoch *et al.* estimates for Sunderland and Liverpool (in preference to either Clark and Hosking or our own estimates) because they are much larger (more than four times larger) and they agree with the estimates of De Vries. The discrepancy for these particular towns is due to Bairoch *et al.* and De Vries including a larger number of parishes in their definitions of Sunderland and Liverpool. The full list of small towns, with their estimated parish and town populations, is given in table A3 below. Remember that the precise population figures are not critical to our analysis: we are using them only to allocate the towns to their appropriate size categories, not to weight the occupational data. Based on this table and the complementary data from Bairoch *et al.*, we estimate that 56.62 per cent of the urban population lived in towns of 5 000 people or more.

¹⁰⁷ Note, in particular, that Clark and Hosking do not report populations for towns in Middlesex, Monmouthshire and Wales, which we require to complete a national stratified sample. We therefore took the 1811 populations of Cardiff, Merthyr-Tydfil, Ogyr and Swansea from Bairoch *et al.*; and the 1811 populations of Edgware, Staines, Twickenham, Abegavenny, Chepstow, Monmouth, Beaumaris, Denbigh, Montgomery, Brecon and Kidwelly from the 1831 census.

Table A3. English parish and urban populations, 1811.

<i>Town</i>	<i>Cty</i>	<i>Parish</i>	<i>Urban</i>	<i>Town</i>	<i>Cty</i>	<i>Parish</i>	<i>Urban</i>
Amphill	1	1299	826	Lutterworth	20	1845	1284
Bedford	1	4605	2538	Market Bosworth	20	2166	865
Biggleswade	1	1895	1155	Market Harborough	20	2530	1704
Dunstable	1	1616	1003	Melton Mowbray	20	2592	2145
Leighton Buzzard	1	3473	2114	Mountsorrel	20	6218	1502
Luton	1	3716	2098	Waltham on the Wolds	20	512	412
Potton	1	1154	744	Alford	21	2204	1169
Shefford	1	860	536	Barton upon Humber	21	2204	1769
Toddington	1	1182	760	Binbrook	21	655	603
Woburn	1	1506	942	Bolingbroke	21	361	356
Abingdon	2	5173	2927	Boston	21	8180	5657
East Ilsley	2	669	477	Bourne	21	1784	1591
Faringdon	2	2343	2103	Brigg	21	1742	1361
Hungerford	2	2073	943	Burgh le Marsh	21	709	647
Lambourn	2	2136	1002	Burton upon Stather	21	526	497
Maidenhead	2	5015	2848	Caistor	21	1235	1051
Newbury	2	4898	2789	Crowland	21	1713	1415
Reading	2		10000	Crowle	21	1575	1424
Wallingford	2	1943	1228	Donington	21	1528	1278
Wantage	2	3036	2386	Epworth	21	1502	1259
Windsor	2	6873	3765	Folkingham	21	659	606
Wokingham	2	2365	1419	Gainsborough	21	5915	5172
Amersham	3	2688	2259	Grantham	21	4777	3686
Aylesbury	3	3447	2013	Grimsbay	21	2747	2150
Beaconsfield	3	1461	940	Holbeach	21	2962	2798
Buckingham	3	2987	1363	Horncastle	21	2622	2063
Chesham	3	4441	2520	Kirton	21	1643	1288
Colnbrook	3	4961	2780	Lincoln	21		7000
Eton	3	2279	1395	Louth	21	4761	4728
Great Missenden	3	1576	1006	Market Deeping	21	899	799
High Wycombe	3	4756	2490	Market Rasen	21	964	850
Ivinghoe	3	1361	883	Market Stainton	21	130	144
Marlow	3	3965	2279	Panton	21	410	398
Newport Pagnell	3	2515	1522	Saltfleet	21	355	350
Olney	3			Sleaford	21	1904	1781
Princes Risborough	3	1644	1044	Spalding	21	4330	3219
Stony Stratford	3	1488	956	Spilsby	21	963	849
Wendover	3	1481	952	Stamford	21	5276	3835
Winslow	3	1222	803	Tattershall	21	714	506
Cambridge	4		10000	Torksey	21	310	240
Caxton	4	317	289	Wainfleet	21	1254	1073
Chatteris	4	2580	1855	Edgeware	22		543
Ely	4		5000	Staines	22		2042
Linton	4	1373	1060	Twickenham	22		3757
Littleport	4	1847	1379	Abergavenny	23		3036
March	4	4602	3098	Chepstow	23		2581
Soham	4	2386	1730	Monmouth	23		3503
Thorney	4	1675	1265	Attleborough	24	1413	862
Whittlesey	4	4248	2886	Aylsham	24	1760	1047
Wisbech	4	6300	4093	Brancaaster	24	617	413
Altrincham	5	6953	2032	Burnham Market	24	825	535
Audlem	5	2587	1040	Castle Rising	24	297	216

Chester	5		15000	Cley next the Sea	24	595	400
Congleton	5	8035	4616	Cromer	24	848	548
Frodsham	5	4098	1349	Diss	24	2590	1474
Halton	5	5947	894	Downham Market	24	1771	1053
Knutsford	5	2855	2114	East Dereham	24	2923	2888
Macclesfield	5	27504	12299	East Harling	24	754	494
Malpas	5	4759	938	Fakenham	24	1382	845
Middlewich	5	4048	1232	Foulsham	24	682	452
Nantwich	5	4236	3999	Great Yarmouth	24		17000
Neston	5	2909	1332	Harleston	24	1516	917
Northwich	5	12628	1382	Hingham	24	1263	780
Over	5	2126	1796	Holt	24	1037	655
Sandbach	5	5391	2311	Kenninghall	24	1102	691
Stockport	5	34762	17545	King's Lynn	24		10000
Tarvin	5	3120	921	Litcham	24	459	318
Bodmin	6	2383	2050	Little Walsingham	24	1008	639
Boscastle	6	608	361	Loddon	24	937	599
Bossiney	6	730	425	Methwold	24	942	601
Callington	6	938	531	New Buckenham	24	656	436
Camborne	6	4714	2221	North Walsham	24	2035	1191
Camelford	6	1100	611	Norwich	24		37000
East Looe	6	951	608	Reepham	24	299	217
Falmouth	6	5307	1374	Setchley	24	347	88
Fowey	6	1319	718	Snettisham	24	880	566
Grampound	6	1990	601	Swaffham	24	2350	2167
Helston	6	5852	2297	Thetford	24	2450	1403
Launceston	6	2895	1442	Watton	24	794	517
Liskeard	6	2884	1975	Wells-next-the-Sea	24	2683	1521
Lostwithiel	6	825	474	Worstead	24	619	414
Marazion	6	2270	1022	Wymondham	24	3923	2130
Mevagissey	6	2225	1142	Brackley	25	1580	1502
Millbrook	6	3678	1596	Daventry	25	2758	2461
Mitchell	6	1679	890	Higham Ferrers	25	823	842
Padstow	6	1498	804	Kettering	25	3242	2840
Penryn	6	3427	2713	King's Cliffe	25	966	971
Penzance	6	5839	4022	Northampton	25		7000
Redruth	6	5903	2712	Oundle	25	1952	1833
Saltash	6	2599	1478	Peterborough	25	4417	3674
St Austell	6	3686	1786	Rockingham	25	230	272
St Columb Major	6	2070	1071	Rothwell	25	1511	1451
St Germans	6	2139	1103	Thrapston	25	708	737
St Ives	6	3281	1611	Towcester	25	2245	2051
St Mawes	6	1639	871	Wellingborough	25	3999	3421
Stratton	6	1094	608	Allendale	26	3884	1596
Tregony	6	923	523	Alnwick	26	5426	2146
Truro	6	9174	4009	Bellingham	26	1232	346
Wadebridge	6	1952	1017	Berwick-upon-Tweed	26	7746	2942
West Looe	6	1234	433	Blyth	26	4388	1522
Abbey Town	7	2438	1706	Corbridge	26	1979	1182
Alston Moor	7	5079	3271	Haltwhistle	26	3355	751
Bootle	7	602	494	Hexham	26	4855	3518
Brampton	7	2543	2043	Morpeth	26	4098	3244
Carlisle	7	13663	7864	Newcastle-upon-Tyne	26		33000
Cockermouth	7	4918	2964	North Shields	26	19042	7699
Egremont	7	1556	1146	Rothbury	26	2428	768
Harrington	7	1621	1188	Tynemouth	26	19042	5834

Ireby	7	399	269	Wooler	26	1704	769
Keswick	7	3656	1683	Bingham	27	1326	332
Kirkoswald	7	945	636	Blyth	27	2930	670
Longtown	7	2693	1579	East Retford	27	2030	484
Maryport	7	3479	3134	Mansfield	27	6816	1416
Penrith	7	4328	2838	Newark-on-Trent	27	7236	1493
Ravenglass	7	591	486	Nottingham	27		29000
Whitehaven	7	16105	10106	Southwell	27	2674	618
Wigton	7	4051	2977	Tuxford	27	841	222
Workington	7	6533	5807	Worksop	27	3702	824
Alfreton	8	3396	1537	Bampton	28	2146	1921
Ashbourne	8	4202	2112	Banbury	28	4173	2841
Bakewell	8	8280	1485	Bicester	28	2269	1921
Belper	8	10853	5778	Burford	28	1584	1342
Bolsover	8	1146	1043	Chipping Norton	28	2331	1975
Chapel-en-le-Frith	8	3042	1394	Deddington	28	1650	1296
Chesterfield	8	7865	4476	Dorchester	28	901	754
Derby	8	15377	5863	Henley-on-Thames	28	3117	2374
Dronfield	8	3115	1343	Oxford	28		12000
Duffield	8	10853	1882	Thame	28	2328	1833
Glossop	8	10797	4285	Watlington	28	1312	1102
Heanor	8	3578	1912	Witney	28	4185	2722
Ilkeston	8	2970	1365	Woodstock	28	1419	1182
Matlock	8	2490	1167	Oakham	29	1719	775
Melbourne	8	2003	962	Uppingham	29	1484	680
Ripley	8	2165	1439	Bishop's Castle	30	1608	1367
Tideswell	8	2038	1219	Bridgnorth	30	4179	1912
Winster	8	3150	847	Brosely	30	4850	2181
Wirksworth	8	6883	3474	Church Stretton	30	943	398
Ashburton	9	3053	2139	Cleobury Mortimer	30	1582	808
Axminster	9	2387	1719	Clun	30	1735	734
Bampton	9	1422	1086	Ellesmere	30	6099	2673
Barnstaple	9	4019	2729	Ludlow	30	4150	1900
Bideford	9	3244	2257	Madeley	30	5076	2271
Bow	9	727	599	Market Drayton	30	3977	1830
Bradninch	9	1321	1018	Much Wenlock	30	2079	1029
Brixham	9	4341	2922	Newport	30	2114	1045
Chagford	9	1197	932	Oswestry	30	6751	3497
Chudleigh	9	1832	1360	Shifnal	30	4061	1315
Chulmleigh	9	1340	1031	Shrewsbury	30		15000
Colyton	9	1774	1322	Wellington	30	8213	3480
Combe Martin	9	732	603	Wem	30	3121	1395
Crediton	9	5178	2788	Whitchurch	30	5012	2589
Cullompton	9	2917	2054	Axbridge	31	835	799
Dartmouth	9	3595	2472	Bath	31	34668	21730
Dodbrooke	9	942	754	Beckington	31	1551	1383
Exeter	9		17000	Bridgwater	31	4911	3842
Exmouth	9	3160	2205	Bristol	31		64000
Great Torrington	9	2151	1568	Bruton	31	1746	1536
Hartland	9	1734	1295	Castle Cary	31	1406	1268
Hatherleigh	9	1380	1058	Chard	31	2932	2432
Holsworthy	9	1206	939	Crewkerne	31	3021	2497
Honiton	9	2735	1940	Dulverton	31	1035	966
Ilfracombe	9	1934	1427	Dunster	31	868	827
Kingsbridge	9	1242	963	Frome	31	9493	6892
Modbury	9	1890	1398	Glastonbury	31	2337	1989

Moretonhamstead	9	1653	1241	Ilchester	31	818	784
Newton Abbot	9	2450	1760	Ilminster	31	2160	1855
Okehampton	9	1554	1440	Keynsham	31	1748	1538
Ottery St Mary	9	2880	2031	Langport	31	861	821
Plymouth	9		16000	Milborne Port	31	1000	937
Plympton	9	715	590	Milverton	31	1637	1451
Sheepwash	9	378	336	Minehead	31	1037	968
Sidmouth	9	1688	1265	Nether Stowey	31	195	220
South Brent	9	1230	955	North Curry	31	1346	1220
South Moulton	9	2739	1942	North Petherton	31	2615	2197
Tavistock	9	4723	3149	Norton St Philip	31	593	590
Teignmouth	9	2893	2039	Pensford	31	978	919
Tiverton	9	6732	4311	Porlock	31	633	625
Topsham	9	2871	2025	Shepton Mallet	31	4638	3652
Totnes	9	2725	1934	Somerton	31	1478	1325
Abbotsbury	10	812	668	South Petherton	31	1867	1630
Beaminster	10	2250	1648	Southgumber	31	1214	1113
Bere Regis	10	1195	941	Taunton	31	6997	5259
Blandford Forum	10	2425	1762	Watchet	31	1659	1468
Bridport	10	3567	2480	Wellington	31	3874	3113
Cerne Abbas	10	795	655	Wells	31	5156	4012
Chideock	10	623	528	Wincanton	31	1850	1617
Corfe Castle	10	1605	1376	Wiveliscombe	31	2550	2149
Dorchester	10	2546	1839	Wrington	31	1109	1027
Evershot	10	485	423	Yeovil	31	3118	2568
Frampton	10	331	301	Abbots Bromley	32	1539	915
Lyme Regis	10	1925	1436	Betley	32	761	490
Melcombe Regis	10	2985	2118	Bilston	32		7000
Milton Abbas	10	619	525	Brewood	32	2860	1584
Poole	10	4816	3237	Burslem	32		7000
Shaftsbury	10	2635	1896	Burton upon Trent	32	6208	3979
Sherborne	10	3370	2358	Cheadle	32	3191	1746
Stalbridge	10	1331	890	Darlaston	32	4881	2545
Sturminster Newton	10	1461	1124	Eccleshall	32	3801	1016
Swanage	10	1483	1139	Leek	32	7483	3703
Wareham	10	1709	1292	Lichfield	32	6546	3301
Weymouth	10	2317	1747	Newcastle-under-Lyne	32	6175	3135
Wimborne Minster	10	3158	2226	Penkridge	32	2486	1937
Barnard Castle	11	5288	2986	Rowley Regis	32		5000
Bishop Auckland	11	7309	1807	Rugeley	32	2213	1262
Chester le Street	11	12264	1726	Sedgley	32		10000
Darlington	11	5820	5059	Stafford	32	5931	3025
Durham	11		8000	Stoke-on-Trent	32		23000
Gateshead	11	8782	2182	Stone	32	6270	3177
Hartlepool	11	1047	331	Tamworth	32	5889	2991
Houghton le Spring	11	8339	1356	Tutbury	32	1235	752
Monkwearmouth	11	6504	1091	Uttoxeter	32	4114	2187
South Shields	11		11000	Walsall	32	11189	5309
Staindrop	11	1950	1087	Wednesbury	32	5372	2770
Stanhope	11	6376	1375	West Bromwich	32	7485	3718
Stockton-on-Tees	11	4406	429	Wolverhampton	32	30249	14836
Sunderland	11	12289	24000	Aldeburgh	33	1066	785
Wolsingham	11	1983	583	Beccles	33	2979	1952
Barking	12	5543	2421	Bildeston	33	762	583
Billericay	12	1533	970	Blythburgh	33	774	591
Bocking	12	2544	1520	Botesdale	33	1221	575

Braintree	12	2298	1389	Brandon	33	1360	974
Brentwood	12	2248	1238	Bungay	33	2828	1864
Burnham	12	1056	697	Bury St Edmunds	33		8000
Chelmsford	12	4649	2593	Clare	33	1170	852
Chipping Ongar	12	678	471	Debenham	33	1224	887
Coggeshall	12	2471	1481	Dunwich	33	208	184
Colchester	12		12000	Eye	33	1893	1306
Dedham	12	1432	913	Framlingham	33	1965	1350
Epping	12	1874	1473	Hadleigh	33	2592	1725
Grays Thurrock	12	1055	696	Halesworth	33	1810	1255
Great Bardfield	12	822	558	Haverhill	33	1440	1025
Great Dunmow	12	2015	1236	Ipswich	33		11000
Halstead	12	3279	1903	Ixworth	33	846	639
Harlow	12	1695	1060	Lavenham	33	1711	1194
Harwich	12	3732	2134	Long Melford	33	2068	1412
Hatfield Broad Oak	12	1321	850	Lowestoft	33	3189	2073
Horndon On The Hill	12	378	280	Mendlesham	33	1093	802
Maldon	12	2679	1591	Mildenhall	33	2493	1667
Manningtree	12	1075	708	Nayland	33	933	697
Rayleigh	12	1131	741	Needham Market	33	1685	1301
Rochford	12	1214	789	Newmarket	33	1917	1320
Romford	12	3244	1885	Orford	33	737	566
Saffron Walden	12	3403	1967	Saxmundham	33	957	713
St Osyth	12	159	130	Southwold	33	1369	980
Thaxted	12	1733	1081	Stowmarket	33	2113	2006
Waltham Abbey	12	3685	2287	Sudbury	33	3471	2235
West Ham	12		6000	Woodbridge	33	4332	2720
Witham	12	2352	1418	Woolpit	33	669	519
Berkeley	13	3236	616	Bletchingly	34	1116	228
Bisley	13	4757	2116	Chertsey	34	3629	649
Blockley	13	1654	830	Croydon	34	7801	1279
Cheltenham	13	8325	3476	Dorking	34	3259	590
Chipping Campden	13	1684	1214	Egham	34	2823	519
Chipping Sodbury	13	1235	640	Elmbridge	34		3000
Cirencester	13	4540	2030	Epsom	34	2515	469
Coleford	13	3147	1551	Farnham	34	4701	2911
Dursley	13	2580	1230	Godalming	34	3543	635
Fairford	13	1444	735	Guildford	34	3357	606
Gloucester	13		8000	Haslemere	34	756	162
Lechlade	13	993	528	Kingston	34	4999	862
Leonard Stanley	13	538	306	Leatherhead	34	1209	245
Lydney	13	1160	606	Putney	34	2881	529
Marshfield	13	1415	722	Reigate	34	2440	128
Minchinhampton	13	3246	1508	Richmond	34	5219	896
Moreton-in-Marsh	13	928	497	Woking	34	1578	310
Mitcheldean	13	535	305	Arundel	35	2188	959
Newent	13	2538	1212	Battle	35	2531	1091
Newnham	13	952	508	Brighton	35	12012	4341
Northleach	13	793	647	Burwash	35	1603	728
Painswick	13	3201	1490	Chichester	35	6425	2493
Stow-on-the-Wold	13	1544	1188	Cuckfield	35	2088	920
Stroud	13	5321	2337	Ditchling	35	740	367
Tetbury	13	2533	1210	East Grinstead	35	2804	1195
Tewkesbury	13	4820	2141	Eastbourne	35	2623	1127
Thornbury	13	3321	1083	Hailsham	35	1029	491
Wickwar	13	805	438	Hastings	35	3345	1398

Winchcombe	13	1936	954	Horsham	35	3839	1579
Wotton-under-Edge	13	3800	1734	Lewes	35	6221	2423
Alton	14	2316	1476	Midhurst	35	1256	586
Andover	14	3295	2017	Petworth	35	2459	1064
Basingstoke	14	2656	1666	Rye	35	2681	1149
Bishop's Waltham	14	1830	1198	Seaford	35	1001	480
Bournemouth	14		0	Shoreham-by-Sea	35	770	380
Christchurch	14	4149	2474	Steyning	35	1210	567
Fareham	14		3325	Storrington	35	72	46
Fordingbridge	14		2259	Wadhurst	35	1815	813
Gosport	14	12212	7788	West Tarring	35	568	290
Havant	14	1824	1194	Winchelsea	35	652	328
Kingsclere	14	1863	1217	Worthing	35	2692	1153
Lymington	14	2641	1658	Alcester	36	1862	1316
New Alresford	14	1044	728	Atherstone	36	3710	2921
Newport	14	3855	2318	Bedworth	36	2794	1886
Newtown	14	690	504	Birmingham	36		71000
Odiham	14	2048	1323	Coleshill	36	1639	1176
Petersfield	14	1525	1280	Coventry	36		16000
Portsmouth	14		33000	Henley-in-Arden	36	2109	1055
Ringwood	14	3269	2003	Kenilworth	36	2279	1575
Romsey	14	4297	1681	Kineton	36	1052	801
Southampton	14	9258	5041	Nuneaton	36	4947	3130
Stockbridge	14	663	487	Polesworth	36	1521	1100
Titchfield	14	3227	1980	Rugby	36	1805	1281
West Cowes	14	3325	2033	Solihull	36	2581	1758
Whitchurch	14	1324	899	Southam	36	1007	763
Winchester	14		6000	Stratford-upon-Avon	36	3803	2842
Yarmouth	14	427	330	Sutton Coldfield	36	2959	1985
Bromyard	15	2594	1101	Warwick	36	6497	3986
Hereford	15		7000	Ambleside	37	2744	624
Kington	15	2312	1655	Appleby	37	2160	956
Ledbury	15	3191	3136	Brough	37	1513	758
Leominster	15	4136	3238	Burton-in-Kendall	37	1230	574
Pembridge	15	1135	881	Kendal	37	13404	7505
Ross-on-Wye	15	2261	1622	Kirkby Lonsdale	37	3235	1368
Weobley	15	626	520	Kirkby Stephen	37	2515	1235
Ashwell	16	754	493	Orton	37	1333	623
Baldock	16	1438	874	Aldbourne	38	1260	565
Barnet	16	1985	1163	Amesbury	38	723	346
Berkhamsted	16	1963	1151	Bradford on Avon	38	8018	2989
Bishop's Stortford	16	2630	1492	Calne	38	3547	1415
Buntingford	16	1494	904	Chippenham	38	3410	1367
Cheshunt	16	3598	1670	Corsham	38	2395	999
Hatfield	16	2677	1516	Cricklade	38	1556	682
Hemel Hempstead	16	4231	3249	Devizes	38	3750	1487
Hertford	16	4595	2447	Downton	38	2624	1084
Hitchin	16	3608	1975	East Lavington	38	1263	899
Hoddesdon	16	2671	1249	Great Bedwin	38	1852	796
Rickmansworth	16	3230	1790	Heytesbury	38	1023	470
Royston	16	1309	804	Highworth	38	2514	601
Sawbridgeworth	16	1827	1080	Hindon	38	781	370
St Albans	16	3050	1701	Ludgershall	38	487	243
Standon	16	1889	1113	Malmesbury	38	2466	1152
Stevenage	16	1302	800	Marlborough	38	3162	1278
Tring	16	2557	1455	Melksham	38	4986	1914

Ware	16	3369	1858	Mere	38	2211	1100
Watford	16	3976	2152	Ramsbury	38	2095	887
Welwyn	16	1130	706	Salisbury	38		8000
Godmanchester	17	1779	798	Swindon	38	1341	598
Huntingdon	17	2397	1040	Trowbridge	38	6075	2281
Kimbolton	17	1400	646	Warminster	38	4866	1873
Ramsey	17	2390	1037	Westbury	38	5942	1799
St Ives	17	2426	1051	Wilton	38	1963	838
St Neots	17	1988	881	Wootton Bassett	38	1390	617
Yaxley	17	1391	642	Bewdley	39	3535	3454
Ashford	18	2532	2113	Bromsgrove	39	6932	4315
Bexley	18	1774	1541	Droitwich	39	1538	1136
Bromley	18	2965	2431	Dudley	39	13925	8009
Canterbury	18		9000	Evesham	39	2430	1704
Chatham	18	12652	8798	Kidderminster	39	12377	8038
Cranbrook	18	2994	2452	Pershore	39	3765	2179
Dartford	18	3177	2584	Shipston-on-Stour	39	1377	1030
Deal	18	7351	5436	Stourbridge	39	9531	4072
Deptford	18		18000	Stourport-on-Severn	39		
Dover	18		11000	Tenbury Wells	39	1562	1151
Eltham	18	1882	1813	Upton upon Severn	39	2023	1448
Faversham	18	3872	3655	Worcester	39		11000
Folkestone	18	4232	3697	Beverley	41	6757	4616
Fordwich	18	252	273	Bridlington	41	4422	3741
Gillingham	18		5000	Frodingham	41	484	446
Goudhurst	18	2082	1777	Great Driffield	41	2025	1857
Gravesend	18	3119	2542	Hedon	41	780	681
Greenwich	18	16947	11400	Hornsea	41	704	622
Hawkhurst	18	1849	1599	Howden	41	3888	1812
Hythe	18	2318	1954	Hunmanby	41	903	775
Lenham	18	1509	1335	Kilham	41	789	688
Lydd	18	1504	1332	Kingston upon Hull	41		30000
Maidstone	18		8000	Market Weighton	41	1864	1508
Margate	18	6126	4625	Patrington	41	1016	860
Milton Regis	18	2059	1759	Pocklington	41	1752	1539
New Romney	18	841	795	Askrigg	42	5170	745
Northfleet	18	2031	1738	Bedale	42	2412	1078
Queenborough	18	805	765	Easingwold	42	1959	1576
Ramsgate	18	5637	4221	Guisborough	42	2094	1834
Rochester	18	6566	4918	Helmsley	42	3366	1415
Sandwich	18	2735	2263	Kirkbymoorside	42	2458	1673
Sevenoaks	18	3444	1922	Malton	42	3713	2130
Sittingbourne	18	1362	1219	Masham	42	2401	1014
Smarden	18	890	836	Middleham	42	714	494
St Mary Cray	18	708	683	Northallerton	42	3727	2234
Strood	18	2504	2092	Pickering	42	3007	2332
Tenterden	18	2786	2300	Richmond	42	3056	1792
Tonbridge	18	5932	4495	Scarborough	42	7067	6710
Tunbridge Wells	18	9272	6679	Stokesley	42	1759	1439
West Malling	18	1154	1053	Thirsk	42	3289	2155
Westerham	18	1437	1279	Whitby	42	10274	6969
Whitstable	18	1785	1550	Yarm	42	1431	915
Woolwich	18	17054	11464	York	42		17000
Wrotham	18	2225	1884	Aberford	43	3343	1038
Wye	18	1322	1188	Aldbrough	43	1902	464
Ashton under Lyne	19	19052	9574	Almondbury	43	19302	4613

Atherton	19	15565	3894	Barnsley	43	9137	5014
Blackburn	19	39899	15083	Batley	43	7507	2975
Bolton	19	39701	17070	Bawtry	43	2930	918
Broughton	19	2394	966	Bingley	43	5769	4782
Burnley	19	63377	4368	Boroughbridge	43	1902	747
Bury	19	27917	8762	Bradford	43	36358	7767
Cartmel	19	3939	1521	Cawood	43	1053	462
Chorley	19	5182	1532	Dalton	43	6544	1625
Clitheroe	19	63377	1767	Dewsbury	43	13479	5059
Colne	19	63377	5336	Doncaster	43	7454	6935
Dalton-in-Furness	19	2074	643	Gisburn	43	2209	509
Ecclestone	19	19738	1584	Halifax	43	73415	9159
Garstang	19	6196	790	Harrogate	43	7348	1583
Haslingden	19	63377	5127	Huddersfield	43	18357	9671
Hawkshead	19	1710	676	Keighley	43	6864	2436
Hornby	19	2001	420	Knaresborough	43	7348	4542
Kirkby	19	2394	1079	Leeds	43		53000
Kirkham	19	10321	2214	Mirfield	43	4315	1614
Lancaster	19	17528	9247	Otley	43	8023	2602
Leigh	19	15565	1960	Pateley Bridge	43	11749	1619
Liverpool	19	94376	83000	Pontefract	43	7493	3605
Manchester	19		84000	Ripley	43	1153	273
Newton-le-Willows	19	14290	1589	Ripon	43	11749	3633
Oldham	19	41342	16690	Rotherham	43	8671	2950
Ormskirk	19	9908	3064	Sedburgh	43	4116	1805
Poulton	19	3390	926	Selby	43	3363	1294
Prescot	19	19738	3678	Settle	43	2760	1153
Preston	19	19528	17065	Sheffield	43	53231	35840
Ribchester	19	3544	1461	Sherburn in Elmet	43	2421	958
Rochdale	19	49808	6723	Skipton	43	4866	2868
Salford	19	136370	1911	Slaithwaite	43	18357	2277
Sefton	19		3000	Snaith	43	5782	743
South Ribble	19		6000	Tadcaster	43	2725	2258
St Helens	19		7000	Thorne	43	2713	1070
Tameside	19		18000	Tickhill	43	1572	1508
Ulverston	19	5867	3378	Wakefield	43	18474	8593
Warrington	19	14614	11738	Wetherby	43	2857	1140
Widnes	19	19738	1204	London	44		900000
Wigan	19	31481	14060	Beaumaris	45		1810
Ashby de la Zouch	20	3403	3141	Denbigh	45		2714
Billesdon	20	665	534	Montgomery	45		932
Castle Donington	20	2308	1566	Brecon	46		3177
Hallaton	20	598	473	Cardiff	46		2000
Hinckley	20	6730	6058	Kidwelly	46		1441
Leicester	20		17000	Merthyr-Tydfil	46		9000
Loughborough	20	5556	5400	Ogwr	46		8000
				Swansea	46		9000

Notes. County ("Cty") key: Bedfordshire=1, Berkshire=2, Buckinghamshire=3, Cambridgeshire=4, Cheshire=5, Cornwall=6, Cumberland=7, Derbyshire=8, Devonshire=9, Dorsetshire=10, Durham=11, Essex=12, Gloucestershire=13, Hampshire=14, Herefordshire=15, Hertfordshire=16, Huntingdonshire=17, Kent=18, Lancashire=19, Leicestershire=20, Lincolnshire=21, Middlesex=22, Monmouthshire=23, Norfolk=24, Northamptonshire=25, Northumberland=26, Nottinghamshire=27, Oxfordshire=28, Rutlandshire=29, Shropshire=30, Somersetshire=31, Staffordshire=32, Suffolk=33, Surrey=34, Sussex=35, Warwickshire=36, Westmorland=37, Wiltshire=38, Worcestershire=39, Yorkshire=40, Yorkshire (East Riding)=41, Yorkshire (North Riding)=42, Yorkshire (West Riding)=43, London=44, Z North Wales=45, Z South Wales=46. Numbers in standard font are taken from Clark and Hosking; numbers in italics are estimated using the model described in

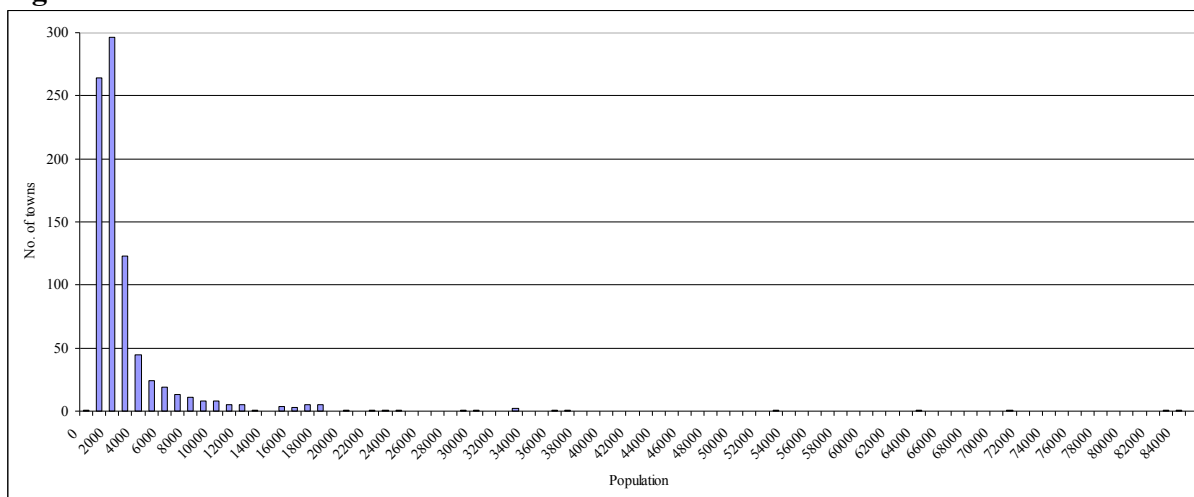
the text; numbers in bold are taken from Bairoch *et al.* or the 1831 census. Since no source gives population data for Olney (Buckinghamshire) or Stourport-on-Severn (Worcestershire), they play no further role in our analysis.

Having established an exhaustive list of towns and their populations, we need to construct a properly stratified sample. We would like the distribution of our sample to match the distribution of the urban population across counties. We would also like the distribution of our sample to match the distribution of the urban population across town sizes. These two criteria together imply that we need to sample at least one town of each size in each county. We can then reflate the sampled towns in the proportions in which towns of those sizes existed in each county, in order to mirror the national distribution of urban population across counties and town sizes.

What do we mean here by “town sizes”? The size distribution of towns is effectively continuous, since it increases in units of one person from zero in Bournemouth to 900 000 in London. Therefore we first allocated towns to different size categories. Why? Because it does not make sense to take a sample of towns of size 10 242 people; and then another sample of towns of size 10 243 people; and so on. If we did this then we would end up entering the data for every town in the population of towns. Instead we need to allocate towns to size categories (“bins”) and sample one town from each size category in each county. We made considerable efforts to set our bins in a way that did as little violence as possible to the data. First, suppose that there were many towns in the range 18 500 to 19 500. Then it would not make sense to set a cut-off at 19 000 because the towns would then be rather arbitrarily allocated to either the bin for “large” towns or for “small” towns. Moreover, since there is undoubtedly a fair amount of measurement error in the data, we could easily end up allocating some of the small towns to the bin of “large” towns and vice versa. In order to avoid this problem we tried to set the cut-off at a point where there was a natural break in the data. In fact, it turns out that there are no towns between 18 000 and 19 111, so 19 000 makes a sensible cut-off. Second, the Bairoch *et al.* data are rounded to the nearest thousand, meaning that a town recorded as having 10 000 people could have had 10 499. But the Clark and Hosking data are not rounded, so a town might be recorded as having 10 001 people. Now suppose that we set the cut-off at 10 000. Then the larger Bairoch *et al.* town would be allocated to the up-to-10 000 bin whilst the smaller Clark and Hosking town could be allocated to the above-10 000 bin. This would obviously allocate the towns to the bins in the reverse importance of their actual sizes. We again avoided this by carefully setting the cut-offs.

The distribution of town sizes is highly skewed, with many small towns and a small number of large towns, as revealed in figure A1 below.

Figure A1. The size distribution of towns in 1811.



In fact, the extensive literature on the size distribution of towns shows that this skewness is a common feature of the pattern of urbanization, with towns in many countries and time periods approximating a power rule known as Zipf's Law.¹⁰⁸ Interestingly, eighteenth century English towns also obeyed Zipf's Law, with a regression of the log of rank on the log of population generating a coefficient of -0.94 (compared to a benchmark figure of -1 for an exact conformity to Zipf's Law).¹⁰⁹ Given this skewness, it makes no sense to split town sizes into categories that are equally large in terms of population. For example, having one category of 0 to 42 000 and another of 42 001 to 84 000 would result in 851 towns in the first bin and 5 towns in the second bin. We therefore set the size of the largest bin and then made the cut-off for the bin below it one half of the size of the largest bin; we repeated this exercise for progressively smaller bins until we came close to zero. This resulted in an approximate doubling of the number of towns each time we dropped one bin size (i.e. the absolute size of the bin was halving each time but the number of towns in it was doubling). This is a standard implication of Zipf's Law. Our procedure should become clear from the bin sizes reported in table A4 below.

Table A4. The size classification and distribution of towns.

Population size bin	Number of towns	Category
152 001 upwards	1	1
76 001 to 152 000	2	2
38 001 to 76 000	3	3
19 001 to 38 000	10	4
9 501 to 19 000	34	5
4 501 to 9 500	65	6
2 251 to 4 500	136	7
1 226 to 2 250	263	8

¹⁰⁸ Kwok Tong Soo, "Zipf's Law".

¹⁰⁹ Note that there is measurement error in our right hand side variable – since most town populations are estimated – which will bias downwards the estimated coefficient; therefore we would expect the estimated coefficient to be slightly less than unity. The regression method is also biased downwards quite substantially in small samples, although this is not a problem for us because we have 857 towns; for a survey of empirical results and technical issues, see Gabaix and Ioannides, "Evolution of city size distributions".

613 to 1 225	231	9
0 to 612	124	10
TOTAL	869	

Since we have 46 counties, choosing to allocate towns to 10 different size categories could mean that we need to sample 460 towns in order to cover all county-size combinations, which is more than one half of the population of towns. Fortunately, it turns out that we need sample only 208 towns in order to achieve full coverage (i.e. towns of some sizes did not exist in some counties). However, there is a complicating factor. There are a small number of large towns and each of them has its own unique character. For example, Liverpool and Manchester are far larger than any other town (outside London) but differ quite markedly from one another in terms of their occupational structure, with one of them being a center for international trade and the other for manufacturing. This means that we would ideally sample both of them – especially since they are the only two towns in the second-largest size category. But this would not happen if we simply sampled one town of each county-size because, not only do they fall into the same size category, but they also fall in the same county (Lancashire). In order to overcome such problems, we decided to sample *all* towns of category 6 and above (i.e. 114 towns).

We then sampled one town from each of the other size categories (6, 7, 8, 9 and 10) in each county and then weighted it by the total number of towns in that county-size category. So, for example, we see in table A5 below that there are seven category 8 towns in Bedfordshire; we entered the data for the first of these (Amphill) and then *de facto* copied it six times in order to reflect the numerical importance of towns of that size in Bedfordshire. In cases where there was more than one town in a particular county-size category (for bins 6 to 10), our rule was to list them in alphabetical order and take the first one. If this had no data (the *UBD* does not report data for absolutely every town in England and Wales) then we worked our way down the alphabetical list until we found a town that did have data in that particular county-size category. For towns in categories 1 to 6, where we intended to sample all towns, we occasionally had a problem of missing data for a particular town. Whenever possible, we took the alphabetically first town in that county-size category and reweighted it to reflect the missing town. For example, in Kent there are no data on Woolwich (a category 5 town) so we double-weighted Deptford to offset this absence.

This procedure pushes our sample up to 241 towns. In 17 county-size categories (mostly small size categories) there were no towns with data. We considered adding towns of the appropriate size from another county in order to make our sample more representative of the overall size distribution; but this would simply have made it less representative of the geographical distribution, so we decided that there was no net benefit from such a strategy. Hence there are a small number of county-size categories missing from our sample but we are confident that this will have no marked effect on our overall results. Having collected our sample, it was straightforward to reflate the towns in categories 7 to 10 in order to generate a sample that was representative of the population of towns.

There are several further complications to our task stemming from the fact that Clark and Hosking present no data on Middlesex, Monmouthshire, South Wales or North Wales. Since we wanted to have a complete geographical coverage, this was problematic. In order to give at least some representation to Monmouthshire, we simply added Abergavenny, Chepstow and Monmouth to our sample; it may be the case that we have still under-sampled small Monmouthshire towns but it seems unlikely that their occupational structure is

sufficiently idiosyncratic that our overall estimates of occupational structure will be significantly biased. On the same basis, we added Brecon, Cardiff, Kidwelly, Llangatock, Merthyr Tydfil and Swansea to represent South Wales; Beaumaris, Denbigh, Montgomery and Newtown to represent North Wales; and Edgware, Staines and Twickenham to represent Middlesex. (Almost all of the Middlesex towns reported in the *UBD*, such as Chelsea, had *de facto* already been swallowed by the London conurbation by the early 1800s. We therefore chose Edgware, Staines and Twickenham because they were still genuinely outside the capital.¹¹⁰)

London is obviously a singleton in category 1. We completed our data collection by taking a random 5 per cent sample of London businesses (i.e. we entered that data from every twentieth page), in addition to taking the complete listings of official occupations (such as government offices, as we discuss in the main text). A more fundamental problem arises in defining the geographical limits of London. The definition of London affects the weight that it has in the national employment structure, since changing the geographical definition changes the estimated population. It is also important that we maintain consistency when merging various data sets, such as those relating to military personal, prisons and workhouses; the original data sets sometimes categorize particular parishes as falling within London, and sometimes not, so we need to be careful. The definition and enumeration of London is not straightforward, since even the original sources are opaque and inconsistent. De Vries takes the data reported in the 1801 census, in the special appendix on London, which seems to be a perfectly reasonable starting point.¹¹¹ Unfortunately, the data in the appendix are difficult to reconcile with the data given in the census enumeration of Middlesex and Surrey. The case of “London without the walls” is particularly puzzling, being 54 151 in the Middlesex enumeration but 147 29 in the appendix; even adding the Surrey parishes in Southwark (67 448) cannot reconcile this discrepancy. We used the discussion in Fletcher – who claims to be following Rickman – to formulate a complete list of parishes, as reported in table A5 below.¹¹² We then took the populations of these parishes from the country enumerations in the census. This gives a total population of 856 191, compared to 864 845 given in the census appendix.

Table A5. Parishes included in our definition of London.

<u>LONDON CITY WITHIN THE WALLS</u>	<u>Population</u>	<u>LONDON CITY WITHOUT THE WALLS</u>	<u>Population</u>
St Albans, Wood St	682	St Andrew, Holborn	5 511
Allhallows, Barking	2 087	St Bartholomew the Great	2 645
Allhallows in Broad St	430	St Bartholomew the Less	952
Allhallows the Great	572	St Botolph without Aldersgate	4 161
Allhallows, Honey Lane	175	St Botolph without Aldgate	8 689
Allhallows the Less	244	St Botolph without Billingsgate	196
Allhallows, Lombard St	699	St Bride	7 078
Allhallows, Staining	714	St Dunstan in the West	3 021
Allhallows, London Wall	1 552	St Giles without Cripplegate	11 446
St Alphage	1 008	St Sepulchre without Newgate	8 092
St Andrew Hubbard	376	Bridewell Precinct	453
St Andrew Undershaft	1 307	Barnard’s Inn	37
St Andrew by the Wardrobe	900	Clement’s Inn	140

¹¹⁰ Clout, *Times London history atlas*, 74-5.

¹¹¹ British Government, *Abstract of the answers and returns made pursuant to... “an act for taking an account of the population of Great Britain”*, 499-503.

¹¹² Fletcher, “*The metropolis*.”

Anne and Agnes within Aldersgate	952	Clifford's Inn	113
St Ann, Blackfriars	3 071	Furnical's Inn	80
St Anthony	363	Gray's Inn	289
St Augustin	333	Inner Temple	485
Bartholomew by the Royal Exchange	560	Lincoln's Inn	179
St Bennet, Fink	539	Middle Temple	382
St Bennet, Gracechurch St	429	Serjeant's Inn, Chancery Lane	22
St Bennet, Paul's Wharf	620	Serjeant's Inn, Fleet St	113
St Bennet, Sherehog	186	Staple Inn	67
St Botolph, Bishopsgate	10 314		
Christ Church	2 818	<u>WESTMINSTER</u>	
St Christopher le Stock	133		
St Clement near East Cheap	352	St Anne	11 637
St Dionas, Blackchurch	868	St Clement Danes	8 717
St Dunstan's in the East	1 613	St George, Hanover Square	38 440
St Edmund the King	477	St James	34 462
St Ethelburga	599	St Margaret	17 508
St Faith the Virgin under St Paul's	964	St John the Evangelist	8 375
St Gabriel, Fenchurch St	509	St Martin in the Fields	25 756
St George, Botolph Lane	254	St Mary le Strand	1 704
St Gregory	1 634	St Paul, Covent Garden	4 992
St Helen near Bishopsgate	655	Palaces of Whitehall and St James	1 685
St James in Duke's Place	851		
St James, Garlick Hithe	595	<u>SOUTHWARK</u>	
St John the Baptist	412		
St John the Evangelist	125	Christ Church	9 933
St John Zachary	507	St George	22 293
St Catherine, Coleman	732	St John	8 892
St Catherine, Cree Church	1 727	St Olave	7 846
St Lawrence, Jury	800	St Saviour	15 596
St Lawrence, Pountney	355	St Thomas	2 078
St Leonard, East Cheap	304	St Thomas Hospital	429
St Leonard, Foster Lane	905	Guy's Hospital	381
St Magnus the Martyr	289		
St Mary Magdalen, Milk St	207	<u>PARISHES IN THE OLD BILLS OF MORTALITY</u>	
St Margaret, Lothbury	569		
St Margaret, Moses	265	<u>Finsbury Division</u>	
St Margaret, New Fish St	365	Old Artillery Ground	1 428
St Margaret, Pattens	221	Charterhouse	249
St Martin, Ironmonger Lane	192	Glass House Yard	1 221
St Martin, Ludgate	1 229	St James, Clerkenwell	23 396
St Martin, Organs	393	St Luke	26 881
St Martin, Outwich	326	St Mary, Islington	10 212
St Martin, Vintry	543	St Supulchre	3 768
St Mary, Abbchurch	549		
St Mary, Aldermanbury	822	<u>Holborn Division</u>	
St Mary, Aldermay	562	St Andrew, Holborn	15 932
St Mary le Bow	468	St George the Martyr	6 273
St Mary Bothaw, Dowgate	236	St Clement Danes	4 144
St Mary, Colechurch	304	Duchy of Lancaster	474
St Mary at Hill	762	St Giles in the Fields	28 764
St Mary Magdalen, Old Fish St	521	St George's, Bloomsbury	7738
St Mary, Mounthaw	366	Rolls Liberty	2 409
St Mary, Somerset	459	St John Baptist, Savoy	320
St Mary, Staining	239	Saffron Hill and Hatton Garden	7 500
St Mary, Woolchurch Haw	270	Ely Place	281
St Mary, Woolnoth	551		
St Matthew, Friday St	209	<u>Tower Division</u>	
St Michael, Bassishaw	747	St Ann, Limehouse	4 678
St Michael, Cornhill	691	St Botolph, Aldgate	6 153
St Michael, Crooked Lane	618	Christ Church, Spitalfields	15 091
St Michael, Queen Hithe	827	St George's in the East	21 170
St Michael le Queen	390	St John, Hackney	12 730
St Michael, Paternoster Royal	307	St John, Wapping	5 889
St Michael, Wood St	574	St Leonard, Shoreditch	34 766
St Mildred, Bread St	281	St Mary, Whitechapel	23 606
St Mildred the Virgin in the Poultry	504	St Matthew, Bethnal Green	22 910
St Nicholas, Acons	275	Mile End, New Town	610
St Nicholas, Cole Abbey	257	Mile End, Old Town	9 848

St Nicholas Olave	324	Norton Falgate	1 752
St Olave, Hart St	1 216	St Paul, Shadwell	8 828
St Olave, Old Jewry	301	Ratcliffe	5 655
St Olave, Silver St	1 078	Tower, or St Catherine's	2 651
St Pancras	217	Liberty of the Tower	563
St Peter, West Cheap	335		
St Peter, Cornhill	1 003	Brixton Division	
St Peter near Paul's Wharf	353	Bermondsey	17 169
St Peter le Poor in Broad St	867	Lambeth	27 939
St Stephen, Coleman St	3 225	Newington Butts	14 847
St Stephen, Walbrook	340	Rotherhithe	10 296
St Swithin, London Stone	474		
St Thomas the Apostle	566	Out-parishes not in the Old Bills of Mortality	
Trinity, Minories	644	St Mary le Bone	63 982
Trinity	558	Paddington	1 881
St Vedast Foster	423	St Pancras	31 779
White Friars Precinct	783	Kensington	8 556
		St Luke, Chelsea	11 604
		TOTAL FOR LONDON	856 191

Our procedures give a grand total of 258 towns in our sample, largely balanced in terms of geographical and size distribution. The population of towns is reported in table A5 below; towns in **bold** were sampled by us from the *UBD*; towns in *italics* were not reported in the *UBD*. To save space, we omit from table A6: London; the two category 2 towns – Liverpool and Manchester (the latter two both being in Lancashire); and the three category 3 towns – Bristol (Somerset), Birmingham (Warwickshire) and Leeds (West Riding of Yorkshire).

Table A6. The size and geographical distribution of English and Welsh towns, c. 1801.

County	Category 4	Category 5	Category 6	Category 7	Category 8	Category 9	Category 10
Beds				Bedford	<i>Leighton Buzzard Luton</i>	Amphill	<i>Shefford</i>
Berks		Reading		Abingdon Maidenhead Newbury Wantage Windsor	Faringdon Wallingford Wokingham	Biggleswade Dunstable Potton Toddington Woburn Hungerford Lambourn	<i>East Ilsley</i>
Bucks				Amersham Chesham Colnbrook High Wycombe	Aylesbury Buckingham Eton Newport Pagnell	Beaconsfield Great Missenden Ivinghoe PrincesRisborough Stony Stratford Wendover Winslow <i>Linton</i>	
Cambs		Cambridge	Ely	March Whittlesey Wisbech	Chatteris Littleport Soham Thorney		Caxton
Ches		Chester Macclesfield Stockport	Congleton	Nantwich Sandbach	Frodsham Knutsford Middlewich Neston Northwich Over	Halton Maplas Tarvin	
Cornwal l				Helston Penryn	Bodmin Camborne	Fowey Marazion	Boscastle Bossiney

				Penzance Redruth Truro	Falmouth Launceston Liskeard Millbrook Saltash St Austell St Ives	Mevagissey Mitchell Padstow St Columb Major St Germans St Mawes Wadebridge	Callington Camelford East Looe Grampound Lostwithiel Stratton Tregony West Looe <i>Bootle</i> <i>Ireby</i> <i>Ravenglass</i>
Cumb		Whitehaven	Carlisle Workington	Alston Moor Cockermouth Maryport Penrith Wigton	<i>Abbey Town</i> Brampton Keswick Longtown	Egremont Harrington Kirkoswald	
Derbys		<i>Belper</i> Derby	Chesterfield Glossop Wirksworth	Alfreton Ashbourne Bakewell Chapel-en-le-F Dronfield Duffield Heanor Ilkeston Ripley	Bolsover Matlock Melbourne Tideswell Winster		
Devon		Exeter Plymouth		Barnstaple Bideford Brixham Crediton Dartmouth Tavistock Tiverton	Ashburton Axminster Chudleigh Colyton Cullompton Exmouth Great Torrington Hartland Honiton Ilfracombe Modbury Moretonham Newton Abbot Okehampton Ottery St Mary Sidmouth South Moulton Teignmouth Topsham Totnes	Bampton Bradninch Chagford Chulmleigh Dodbrooke Hatherleigh Holsworthy Kingsbridge South Brent	Bow Combe Martin Plympton Sheepwash
Dorset				Bridport Poole Sherborne	Beaminster Blandford Forum Corfe Castle Dorchester Lyme Regis Melcombe Shaftesbury Wareham Weymouth Wimborne Minster <i>Bishop Auckland</i>	Abbotsbury Bere Regis Cerne Abbas Stalbridge SturminsterNewton Swanage	<i>Chideock</i> Evershot Frampton Milton Abbas
Durham	Sunderland	<i>South Shields</i>	Darlington Durham	BarnardCastle	Chester le Street Gateshead HoughtonleSpring Stanhope <i>Bocking</i>	Monkwearmouth Staindrop	Hartlepool Stockton Wolsingham
Essex		Colchester	<i>West Ham</i>	<i>Barking</i> Chelmsford WalthamAbbe y	<i>Braintree</i> Brentwood	Billericay Burnham Dedham	<i>Chipping</i> <i>Ongar</i> <i>Great</i> <i>Bardfield</i> Horndon

Lancs	<i>Salford</i>	Ashton u Lyne Blackburn	Bury Colne	<i>Atherton</i> Burnley	Strood Westerham Whitstable Wrotham Cartmel Chorley	<i>Broughton</i> Dalton-in-Furness Garstang Hawkshead Kirkby Poulton Widnes	Hornby
		Bolton <i>Oldham</i> Preston <i>Tameside</i> Warrington	Haslingden Lancaster Rochdale <i>South Ribble</i> <i>St Helens</i>	Ormskirk Prescot Sefton Ulverston	Clitheroe Eccleston Kirkham Leigh Newton-le-Willows Ribchester <i>Castle</i> <i>Donington</i> Lutterworth MarketHarborou gh Melton Mowbray Mountsorrel	Market Bosworth	<i>Billesdon</i> <i>Hallaton</i> <i>Waltham on W</i>
Leics		Wigan Leicester	Hinckley Loughborough	Ashby de la Z	Barton upon H Bourne Brigg		
Lincs			Boston Gainsborough Lincoln	Grantham Holbeach Spalding	Barton upon H Bourne Brigg	Alford Burgh le Marsh Caistor	Binbrook Bolingbroke Burton upon Sta Folkingham Market Stainton Panton Saltfleet Tattershall Torksey
			Louth	Stamford	Crowland Crowle	Market Deeping Market Rasen	
Midx					Donington Epworth Grimsby Horncastle Kirton Sleaford	Spilsby Wainfleet	
Mmouth				Staines	Twickenham	Edgware	
Norfolk		Great Yarmouth King's Lynn		Monmouth East Dereham	Abergavenny Diss	Chepstow Attleborough	<i>Brancaster</i>
					Swaffham	Aylsham	<i>BurnhamMark et</i>
					Thetford Wells-next-the-Sea Wymondham	Downham Fakenham	Castle Rising Cley next the S Cromer East Harling Foulsham Litcham Loddon Methwold NewBuckenham Reepham Setchey Snettisham Watton Worstead <i>Rockingham</i>
Northants			Northampton	Daventry	Brackley	<i>Higham Ferrers</i>	
				Kettering Peterborough Wellingborough	Oundle Rothwell Towcester	<i>King's Cliffe</i> Thrapston	
Northumb	Newcastle		<i>North Shields</i> <i>Tynemouth</i>	Berwick-upon- Hexham Morpeth	Allendale	Corbridge	Bellingham
					Alnwick Blyth	Haltwhistle Rothbury Wooler <i>Blyth</i>	
Notts	Nottingham				Mansfield		Bingham

Oxon		Oxford		Banbury Henley-on-Tha Witney	Newark-on-Trent Bampton Bicester Burford Chipping Norton Deddington Thame Oakham Uppingham Bishop's Castle	Southwell Worksop <i>Dorchester</i> <i>Watlington</i> Woodstock	East Retford Tuxford
Rutland							
Salop		Shrewsbury		Ellesmere Madeley Oswestry Wellington Whitchurch	Bridgnorth Brosely Ludlow Market Drayton Shifnal Wem	CleburyMortimer Clun Much Wenlock Newport	ChurchStretton
Somerset	Bath		Frome Taunton	Bridgwater Chard	Beckington Bruton	Axbridge Dulverston	<i>Nether Stowey</i> Norton StPhilip Wrighton
				Crewkerne SheptonMallett Wellington Wells Yeovil	Castle Cary Glastonbury Ilminster Keynesham Milverton North Petherton Somerton South Petherton Watchet Wincanton Wiveliscombe	Langport Milborne Port Minehead North Curry Pensford Porlock Stogumber	
Staffs	Stoke-on-T	<i>Sedgley</i> Wolverhampton	Bilston Burslem <i>Rowley Regis</i> Walsall	Burton upon T Darlston Leek Lichfield Newcastle Stafford Stone Tamworth Wednesbury West Bromwich	Brewood Cheadle Penkridge Rugeley Uttoxeter	<i>Abbots Bromley</i> Eccleshall Tutbury	Betley
Suffolk		Ipswich	BuryStEdmunds	Woodbridge	Beccles Bungay Eye Framlingham Hadleigh Halesworth Long Melford Lowestoft Mildenhall Needham Market Newmarket Stowmarket Sudbury	Aldeburgh Brandon Clare Debenham Haverhill Ixworth Lavenham Mendlesham Nayland Saxmundham Southwold	Bildeston Blythburgh Botesale Dunwich Orford Woolpit
Surrey				<i>Elmbridge</i> Farnham	Croydon	Chersey Godalming Kingston Richmond	<i>Bletchingley</i> Dorking Egham Epsom Guildford Haslemere

Sussex				Brighton Chichester Lewes	Hastings Horsham	Arundel Battle Burwash Cuckfield East Grinstead Eastbourne Petworth Rye Wadhurst Worthing Coleshill	Leatherhead Putney Reigate Woking <i>Ditchling</i> <i>Hailsham</i> Midhurst Seaford Shoreham-by- S Steyning Storrington West Tarring Winchelsea
Warwick s		Coventry		Atherstone Nuneaton Stratford- upon- Warwick	Alcester Bedworth Kenilworth Rugby Solihull Sutton Coldfield	Henley-in-Arden Kineton Polesworth Southam Ambleside	Burton-in- Kend
Wilts			Kendal		Kirkby Lonsdale Kirkby Stephen	Appleby Brough Orton Corsham	<i>Aldbourne</i>
			Salisbury	Bradford on A Trowbridge	Calne Chippenham Devizes Marlborough Melksham Warminster Westbury	Cricklade Downton East Lavington Great Bedwin Malmesbury Mere Ramsbury Wilton Wootton Bassett	Amesbury Heytesbury Highworth Hindon Ludgershall Swindon
Worcs		Worcester	Dudley Kidderminster	Bewdley Bromsgrove Stourbridge	Evesham Pershore UptonuponSevern	Droitwich Shipston-on-Stour Tenbury Wells	
ERYork s	Kingston		Beverley	Bridlington	Great Driffield Howden Market Weighton Pocklington	Hedon Hornsea Hunmanby Kilham Pattrington <i>Askrigg</i>	<i>Frodingham</i>
NRYork s		York	Scarborough Whitby	Pickering	Easingwold Guisborough Helmsley Kirkbymoorside Malton Northallerton Richmond Stokesley Thirsk Dalton	Bedale Masham Yarm	<i>Middleham</i>
WRYork s	Sheffield	Huddersfield	<i>Almondbury</i> Barnsley <i>Bingley</i> Bradford <i>Dewsbury</i> Doncaster Halifax Knaresborough Wakefield	<i>Batley</i> Keighley Otley Pontefract Ripon Rotherham Skipton Slaithwaite Tadcaster	<i>Harrogate</i> Mirfield Pateley Bridge Sedbergh Selby Tickhill	Aberford Bawtry Boroughbridge Settle Sherburn in Elmet Snaith Thorne Wetherby	<i>Aldbrough</i> Cawood Gisburn Ripley

NWales SWales			Denbigh Merthyr- Tydfil <i>Ogwr</i> Swansea	Newtown	Montgomery Cardiff	Beaumaris Brecon Llangadack	Kidwelly
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Appendix 2. The synthetic occupational census for 1801.

Table A6. National occupational classification for 1801.

Class and sub-class	Occupation	ID	R	N	
1.1 National government	Post Office	1	1	8 661	
	Inland Revenue	2	1	4 843	
	Customs	3	1	9 550	
1.2 Local government	Other government officers	4	1	14 571	
	Police	5	2	3 218	
	Union relieving officer	6	1	681	
	Office of local board	7	4	682	
1.3 East India government	County, local, -officer (not otherwise distinguished)	8	4	4 160	
	East India Service	9	1	1 711	
2.1 Army – at home	Army officer	10	1	4 034	
	Army half-pay officer	11	1	2 429	
	Soldier	12	1	79 732	
2.2 Navy – ashore or in port	Chelsea pensioner	13	1	20 712	
	Navy officer	14	1	2 421	
	Navy half-pay officer	15	1	2 038	
	Seaman, R.N.	16	1	46 782	
	Greenwich pensioner	17	1	5 349	
	Marine	18	1	9 153	
	Others engaged in defence	19	4	213	
3.1 Clergymen and ministers	Clergyman	20	1	52 113	
	Protestant minister (not otherwise described)	21	4	3 709	
3.2 Lawyers	Priest of other religious bodies	22	4	1 169	
	Barrister, advocate, special pleader, conveyancer	23	2	356	
	Solicitor, attorney, writer to signet	24	2	1 964	
3.3 Physicians and surgeons	Other lawyers	25	2	57	
	Physician	26	2	924	
	Surgeon, apothecary	27	2	1 170	
	Other medical men	28	2	45	
3.4 Church officers	Parish clerk, clerk to church	29	4	1 203	
	Other union, district, parish officer	30	2	114	
3.5 Law clerks, court officers, stationers	Law clerk	31	4	7 150	
	Law stationer	32	4	1 192	
3.6 Chemists, surgical instrument makers	Druggist	33	2	837	
	Others dealing in drugs	34	2	4	
4.1 Authors	Author	35	4	206	
	Editor, writer	36	2	145	
	Others engaged in literature	37	2	1	
4.2 Artists	Painter (artist)	38	2	56	
	Architect	39	2	50	
	Others engaged in the fine arts	40	2	12	
4.3 Scientific persons	Scientific person, observatory and museum keeper, naturalist, etc.	41	4	226	
4.4 Teachers	Music-master	42	2	70	
	Schoolmaster, schoolmistress	43	4	30 078	
	Governess	44	4	10 235	
	Other teachers	45	2	83	
	Wife (of no specified occupation)	46	4	1 161 869	
5.1 Wives	Widow (of no specified occupation)	47	4	119 073	
5.2 Widows	Son, grandson, brother, nephew (not otherwise returned)	48	4	878 958	
5.3 Children	Daughter, grand-daughter, sister, niece (not otherwise returned)	49	4	1 203 250	
	Scholar – under tuition at home	50	4	24 781	
5.4 Scholars	Scholar – under tuition at school or college	51	4	1 147 386	
6.1 In boarding and lodging	Innkeeper	52	2	7 619	
	Innkeeper's wife	53	3	4 640	
	Lodging-house keeper	54	2	17	
	Officer of charitable institution	55	4	721	
	Others – boarding and lodging	56	2	109	
	6.2 In attendance (domestic servants, etc.)	Domestic servant (general)	57	4	331 401
		Housekeeper	58	4	23 802
Cook		59	4	22 456	
Housemaid		60	4	25 454	
Nurse		61	4	18 337	
Inn servant		62	3	16 008	
Nurse at hospital, etc.		63	2	11 404	
Midwife		64	4	1 033	

	Charwoman	65	4	27 396
	Coachman	66	4	3 587
	Groom	67	4	7 785
	Gardener (servant)	68	4	2 301
6.3 In providing dress	Hairdresser, wig-maker	69	2	2 751
	Hatter	70	2	2 158
	Straw hat, bonnet, -maker	71	4	13 108
	Furrier	72	2	51
	Tailor	73	2	14 026
	Cap, -maker, dealer	74	2	214
	Milliner, dressmaker	75	2	19 478
	Shirtmaker, seamster	76	4	30 311
	Shawl manufacturer	77	4	149
	Staymaker	78	2	4 443
	Hosier, haberdasher	79	2	1 042
	Hose (stocking) manufacture	80	4	30 066
	Laundry-keeper, mangler	81	2	14 205
	Rag, -gatherer, dealer	82	2	40
	Glover (material not stated)	83	2	116 489
	Shoemaker, bootmaker	84	2	22 226
	Shoemaker's wife	85	3	7 497
	Patten, clog, -maker	86	2	336
	Umbrella, parasol, stick, -maker	87	2	85
	Others providing dress	88	2	5 760
7.1 Buy, sell, let, lend goods or money	House proprietor	89	4	14 667
	Merchant	90	2	1 867
	Banker	91	2	2 309
	Ship-agent	92	2	54
	Broker	93	2	561
	Agent, factor	94	2	185
	Salesman, saleswoman	95	2	257
	Auctioneer, appraiser, valuer	96	2	366
	Accountant	97	2	335
	Commercial clerk	98	2	951
	Commercial traveller	99	4	4 265
	Pawnbroker	100	2	186
	Shopkeeper (branch undefined)	101	2	1 065
	Shopkeeper's wife	102	3	232
	Hawker, pedlar	103	2	21 679
	Other general merchants, dealers, agents	104	2	1 623
8.1 Railways	Railway engine, -driver, stoker	105	1	0
	Others engaged in railway traffic	106	1	0
8.2 Roads	Toll collector	107	2	272
	Coach and cab owner	108	2	109
	Livery-stable keeper	109	2	41
	Coachman (not domestic servant), guard, postboy	110	3	794
	Carman, carrier, carter, drayman	111	2	18 412
	Omnibus, -owner, conductor	112	1	0
	Others engaged in road conveyance	113	2	163
8.3 Canals	Canal and inland navigation service	114	2	818
	Boat and bargeman	115	2	55 551
	Others connected with inland navigation	116	2	11 258
8.4 Seas and rivers	Shipowner	117	2	34
	Seaman (merchant service)	118	1	123 051
	Pilot	119	2	100
	Others connected with sea navigation	120	2	869
8.5 Warehousemen and storekeepers	Warehouseman	121	2	3 743
	Others connected with storage	122	2	98
8.6 Messengers and porters	Messenger, porter (not government), errand-boy	123	2	5 351
	Others employed about messages	124	2	30
9.1 In fields and pastures	Land proprietor	125	5	30 315
	Farmer	126	5	185 372
	Grazier	127	5	7 415
	Farmer's, grazier's wife	128	3	123 554
	Farmer's, grazier's son, grandson, brother, nephew	129	3	83 839
	Farmer's, grazier's daughter, grand-daughter, sister, niece	130	3	78 917
	Farm bailiff	131	3	8 163
	Agricultural labourer (outdoor)	132	5	667 083
	Shepherd	133	3	9 675
	Farm servant (indoor)	134	5	309 617

	Others connected with agriculture	135	2	1 386
9.2 In woods	Woodman	136	3	6 007
	Others connected with arboriculture	137	4	120
9.3 In gardens	Gardener	138	3	2 380
	Nurseryman	139	2	139
	Others connected with horticulture	140	2	0
10.1 Persons engaged about animals	Horse-dealer	141	2	790
	Groom (not domestic servant), horse-keeper, jockey	142	4	13 985
	Farrier, veterinary surgeon	143	2	855
	Cattle, sheep, dealer, salesman	144	2	100
	Drover	145	4	1 516
	Gamekeeper	146	4	3 848
	Vermin-destroyer	147	4	884
	Fisherman	148	1	18 789
	Others engaged about animals	149	2	145
11.1 In books	Bookseller, publisher	150	2	588
	Bookbinder	151	2	287
	Printer	152	2	1 079
	Others engaged about publications	153	2	60
11.2 In plays (actors)	Actor	154	4	621
	Others engaged about theatres	155	2	0
11.3 In music	Musician (not teacher)	156	2	18 040
	Musical instrument, -maker, dealer	157	2	37
	Others connected with music	158	2	46
11.4 In pictures and engravings	Engraver	159	2	129
	Others employed about pictures and engraving	160	2	84
	Others employed about figures and carving	161	2	54
11.5 In carving and figures	Artificial flower maker	162	4	1 490
11.6 In shows and games	Toy, -maker, dealer	163	2	138
	Persons connected with shows, games and sports	164	2	0
11.7 In plans and designs	Civil engineer	165	4	1 315
	Pattern designer	166	4	808
	Other designers and draughtsman	167	4	304
11.8 In medals and dies	Medalist and medal-maker	168	4	240
11.9 In watches, philosophical instruments	Watchmaker, clockmaker	169	2	2 368
	Philosophical instrument maker	170	2	139
11.10 In arms	Gunsmith	171	2	441
	Others engaged in the manufacture of arms	172	2	100
11.11 In machines	Engine and machine maker	173	2	2 263
	Tool-maker	174	2	484
	Others dealing in tools and machines	175	2	623
11.12 In carriages	Coachmaker	176	2	980
	Others connected with carriage making	177	2	0
11.13 In harness	Saddler, harness-maker	178	2	2 214
	Whip-maker	179	2	91
	Other harness-makers	180	2	0
11.14 In ships	Shipwright, shipbuilder	181	2	5 920
	Boat, barge, -builder	182	2	353
	Others engaged in fitting ships	183	2	408
11.15 In houses	Surveyor	184	2	209
	Builder	185	2	413
	Carpenter, joiner	186	2	25 436
	Bricklayer	187	2	11 124
	Mason, pavior	188	2	9 601
	Slater	189	2	653
	Plasterer	190	2	2 545
	Painter, plumber, glazier	191	2	8 380
	Others engaged in house construction	192	2	7
11.16 In implements	Wheelwright	193	2	1 832
	Millwright	194	2	1 429
	Other implement makers	195	2	46
11.17 In chemicals	Dyer, scourer, calenderer	196	2	1 737
	Others engaged in manufacture of chemicals	197	2	1 309
12.1 In animal food	Cowkeeper, milkseller	198	2	464
	Cheesemonger	199	2	347
	Butcher, meat salesman	200	2	6 018
	Butcher's wife	201	3	2 356
	Provision curer	202	1	4
	Poulterer, gamedealer	203	2	35
	Fishmonger, dealer, seller	204	2	326

	Others dealing in animal food	205	2	184
12.2 In grease, bone, horn, ivory, intestines	Soap-boiler	206	2	858
	Tallow-chandler	207	2	3 210
	Comb-maker (for manufactures)	208	2	191
	Others dealing in grease and bones	209	2	73
12.3 In skins	Fellmonger	210	2	447
	Skinner	211	4	818
	Currier	212	2	3 706
	Tanner	213	2	8 216
	Other workers in leather	214	2	330
12.4 In feathers and quills	Feather, -dresser, dealer	215	2	3
12.5 In hair and fur	Hair, bristle, -manufacture	216	4	438
	Brush, broom, -maker	217	2	349
	Other workers, dealers in hair	218	4	896
12.6 In wool	Woolstapler	219	2	2 802
	Knitter	220	4	1 290
	Woolen cloth manufacture	221	2	206 117
	Fuller	222	4	740
	Worsted manufacture	223	2	12 525
	Stuff manufacture	224	2	11 575
	Clothier	225	2	20 755
	Woolen draper	226	2	327
	Carpet, rug, -manufacture	227	2	13 700
	Other workers, dealers in wool	228	2	3 316
12.7 In silk	Silk manufacture	229	2	4 041
	Silkmercer	230	2	46
	Ribbon manufacture	231	4	5 140
	Fancy goods manufacture	232	4	930
	Embroiderer	233	4	1 281
	Other workers, dealers in silk	234	2	422
13.1 In vegetable food	Greengrocer	235	2	70
	Corn merchant	236	2	419
	Miller	237	2	1 936
	Flour-dealer	238	2	225
	Baker	239	2	4 954
	Confectioner	240	2	527
	Others dealing in vegetable food	241	2	758
13.2 In drinks and stimulants	Maltster	242	2	4 109
	Brewer	243	2	8 449
	Licensed victualler, beershopkeeper	244	2	7 650
	Licensed victualler, beershopkeeper's wife	245	3	4 447
	Wine and spirit merchant	246	2	1 311
	Sugar-refiner	247	2	13
	Grocer	248	2	9 062
	Tobacconist	249	2	188
	Others dealing in drinks, stimulants	250	2	1 196
13.3 In gums and resins	Oil and colourman	251	2	83
	French-polisher	252	4	1 571
	Other workers, dealers in oils, gums, etc.	253	2	304
13.4 In timber	Timber merchant	254	2	538
	Other dealers, workers in timber	255	2	57
13.5 In bark	Cork-cutter	256	2	211
	Others dealing in bark	257	2	5
13.6 In wood	Sawyer	258	2	1 584
	Lath-maker	259	2	80
	Other wood workers	260	4	43
13.7 In wood furniture	Cabinet-maker, upholsterer	261	2	4 345
	Turner	262	2	827
	Chair-maker	263	2	378
	Box-maker	264	2	35
	Others dealing in wood furniture	265	2	34
13.8 In wood utensils	Cooper	266	2	3 629
	Other makers of wood utensils	267	2	0
13.9 In wood tools	Frame-maker	268	4	757
	Block and print cutter	269	4	387
	Other wood tool makers	270	2	202
13.10 In cane, rush and straw	Basket-maker	271	2	729
	Thatcher	272	4	3 004
	Straw plait manufacture	273	4	14 013
	Other workers in cane, rush, straw	274	2	26

13.11 In hemp	Ropemaker	275	2	1 131	
	Sailcloth manufacture	276	2	1 954	
	Others working in hemp	277	2	2 330	
13.12 In flax, cotton	Flax, linen, -manufacture	278	2	145 400	
	Thread manufacture	279	4	430	
	Weaver (material not stated)	280	2	0	
	Draper	281	2	40 919	
	Lace manufacture	282	2	5 088	
	Cotton manufacture	283	2	235 755	
	Lint manufacture	284	2	2	
	Packer and presser (cotton)	285	2	1	
	Fustian manufacture	286	4	2 809	
	Muslin embroiderer	287	4	31	
	Calico, cotton, -printer	288	4	6 173	
	Calico, cotton, -dyer	289	4	1 662	
	Other workers, dealers in flax, cotton	290	2	993	
	13.13 In paper	Paper manufacture	291	2	994
Stationer		292	2	369	
Paper-stainer		293	2	135	
Paper-hanger		294	2	6	
Other paper workers, dealers		295	2	36	
14.1 In coal		Coal-miner	296	2	79 871
		Coal, -merchant, dealer	297	2	402
	Coal, -heaver, labourer	298	4	6 636	
	Chimney-sweeper	299	2	26	
	Gasworks service	300	1	0	
	Other workers, dealers in coal	301	2	278	
	14.2 In stone, clay	Stone-quarrier	302	2	436
		Slate-quarrier	303	1	1 367
		Limestone, -quarrier, burner	304	2	518
		Marble mason	305	4	550
Brick, -maker, dealer		306	2	1 737	
Road labourer		307	4	4 047	
Railway labourer		308	1	0	
Other workers in stone, lime, clay		309	2	1 027	
14.3 In earthenware		Earthenware manufacture	310	2	28 775
		Earthenware and glass dealer	311	2	516
	Tobacco-pipe maker	312	2	213	
14.4 In glass	Glass manufacture	313	2	633	
	Other workers, dealers in glass	314	2	221	
14.5 In salt	Salt, -agent, merchant, dealer	315	2	214	
14.6 In water	Water, -carrier, dealer	316	4	844	
14.7 In precious stones	Workers, dealers in precious stones	317	2	42	
14.8 In gold and silver	Goldsmith, silversmith	318	2	1 43	
	Plater	319	2	586	
	Carver, gilder	320	2	157	
	Other workers, dealers in gold and silver	321	4	1 670	
	14.9 In copper	Copper-miner	322	1	8 250
		Copper manufacture	323	1	6 750
Coppersmith		324	2	287	
Other workers, dealers in copper		325	4	196	
14.10 In tin		Tin-miner	326	1	2 688
	Tinman, tin-worker, tinker	327	2	7 017	
	Other workers, dealers in tin	328	4	4 839	
	Zinc manufacture	329	2	225	
14.11 In zinc	Other workers and dealers in zinc	330	4	14	
	14.12 In lead	Lead-miner	331	4	10 220
Lead manufacture		332	2	10	
Other workers, dealers in lead		333	2	437	
14.13 In brass and mixed metals		Brass, -manufacture, founder, moulder	334	2	728
		Locksmith, bellhanger	335	2	1 019
	Brazier	336	2	5 578	
	White metal manufacture	337	4	316	
	Pin manufacture	338	2	83	
	Button-maker (all branches)	339	2	480	
	Wire, -maker, drawer	340	2	84	
	Wire, -worker, weaver	341	2	167	
	Other workers, dealers in mixed metals	342	2	3 079	
	14.14 In iron and steel	Iron-miner	343	4	9 889
Iron, manufacture, moulder, founder		344	2	6 973	

	Whitesmith	345	2	3 616
	Blacksmith	346	2	8 018
	Nail manufacture	347	2	4 337
	Anchorsmith, chainsmith	348	2	174
	Boiler-maker	349	4	3 072
	Ironmonger	350	2	1 405
	File-maker	351	2	137
	Cutler	352	2	519
	Needle manufacture	353	2	1 758
	Grinder (branch undefined)	354	2	31
	Other workers, dealers in iron, steel	355	2	2 496
15.1 Labourers (branch undefined)	Labourer (branch undefined)	356	4	169 288
15.2 Other persons of indefinite employ	Mechanic, manufacturer, shopman, shopwoman	357	2	111 011
15.3 Others of indefinite occupations	Others of indefinite occupations	358	4	984
16.1 Other persons of rank or property	Gentleman, gentlewoman, independent	359	4	12 929
	Annuitant	360	4	63 562
	Others of independent means	361	4	86
17.1 Living on income from other sources	Dependent on relatives (not classed elsewhere)	362	4	7 958
	Almsperson	363	4	4 190
	Pauper of no stated occupation	364	1	40 953
	Lunatic of no stated occupation	365	4	4 056
	Others supported by the community	366	4	198
17.2 Prisoners (of no stated occupation)	Prisoner of no stated occupation	367	1	1 490
17.3 Vagrants (of no specified occupation)	Vagrant in barns, tents, etc.	368	4	9 340
	Persons of no stated occupations or conditions and persons not returned under the foregoing items	369	4	79 964
	TOTAL			9 163 586

Notes and sources. Classes and sub-classes and occupations are all as listed in the 1851 town-level census. R is the estimation rule that we adopted: 1 – the absolute number of people in this occupation taken from a contemporary source (usually a Parliamentary enquiry or the establishment list of a government department or the military); 2 – the share of this occupation reported in the *UBD* (reinflated by the number of employees for each type of business) applied to the 1801 population total; 3 – taking the observed ratio in 1851 and applying it to 1801 (such as taking the ratio of “Shopkeepers’ wives” to “Shopkeepers” in 1851 and applying this to the number of “Shopkeepers” in 1801); 4 – assuming that this occupation was the same percentage of the total population in 1801 as in 1851 (such as “Wives (of no stated occupation)”); 5 – applying the results of Young’s agricultural survey to land data for 1801. We occasionally use rule 4 to estimate a working occupation, rather than a non-working occupation. Why? Some occupations do not appear in the *UBD* at all, such as calico dyer, even though they must have existed (there was a lot of calico that must have been dyed in 1801). So we can either slavishly apply rule 2 – even though we know that the answer must be wrong – or we can apply some other rule to move us in the right direction. We choose to apply rule 4, as a first approximation. Rule 4 generates an additional problem, however. Once we have estimated the national total for a particular occupation, we need to think about how it was allocated locally, since we are going to produce town-level estimates. For most occupations we assume that people working in that occupation were distributed proportionately across the population. For some occupations, this is clearly false. So we assume, for example, that each town had zero “Agricultural labourer (outdoor)” (since they mostly lived in the countryside) and zero “Copper miner” (since they were concentrated in a very specific location).

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Regional specialization in England and Wales in 1801 and 1851

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Abstract

Regional census tables for each of the 45 English and Welsh counties are estimated for 1801 with a professional structure identical to 1851, allowing detailed analysis of regional change. Regional dynamics and the interplay between transport, emerging and declining sectors and professions are quantified and discussed. Lancashire and surrounding counties, as well as Birmingham and connecting areas, experienced strong growth in manufacturing and associated occupations. Counties around London and in the north specialised in farming. Weaving and woollen cloth manufacturing diminished strongly and became more concentrated. I observe Marshallian growth with industrial concentration levels in sectors central to the industrial revolution rising considerably over the period.

Keywords: Census, structural change, industrialization, industrial revolution, regional analysis, Marshallian growth.

JEL classifications: J21, N13, O14, Y4.

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0. Introduction. The industrial revolution in England is one of the better-documented historical events in economic history. Deane and Cole's (1962) estimates, refined by Craft (1985) are well known examples. These offered new estimates of economic growth and an overview of changes in economic activity. Substantial consideration has centred on overall industrial output and on growth in specific sectors, such as iron and cotton. The impact on, and growth in, particular regions and professions has also been widely discussed. For example Hudson (1991) discusses regional development of the wool-textile industry and the industrialization of (amongst others) the West-Riding, Cumbria and the Midlands. Houston (1984) analyses weaving and cottage industry and deepens our understanding of the concept of proto-industrialization.

This paper takes a more complete and quantitative approach to regional and sectorial analysis. For each of the 45 English and Welsh counties, a population breakdown using the structure of the 1851 county tables is made. This classifies the population into 369 occupations in 17 occupational groups. When comparing 1801 to the corresponding 1851 census tables, we are able to quantify many of the historical developments found and discussed over the years in the literature on the early industrial revolution. A detailed analysis can be found in sections three and four of this paper, but the key results are as follows. With a notable exception, namely transport, most occupations were more concentrated in 1851 than 1801. For literally all regions, the defence of the country employed fewer people in 1851 than in 1801 (the height of the Napoleonic wars). Although there were relatively fewer farmers in 1851 than in 1801, the counties surrounding London and Lancashire actually became more specialised in farming. The number of mechanics more than doubled and exploded in Lancashire and surrounding counties. Woollen cloth production lost importance and became concentrated in and around West Yorkshire. Flax and linen manufacture was widespread in 1801, but collapsed before 1851. Cotton manufacture was more labour-intensive but also more widespread in 1801; by 1851 many counties had only negligible production capacity left and Lancashire had gained ground. The overall level of industrial specialisation, on average, remained very stable from 1801 to 1851, but there are important clusters within specific occupations.

1. Literature. There is an abundant qualitative literature on the causes and consequences, of the English industrial revolution. But articles quantifying the industrial revolution often focus on specific key sectors, such as cotton and iron (Crafts and Harley 1992); or have modelled publicly available data such as output for certain industries, or imports and exports found in the Parliamentary Papers. Popular data used include town populations, prices, taxes, acreages and wages. A good example of how these sources are applied is McCloskey (1994). She gives an excellent analysis of the causes and the evolution from 1780 to 1860. Reading this, and similar surveys, enables readers to understand the why and how of industrialization. McCloskey, and Crafts and Harley, estimate the impact of manufacturing industries such as cotton, iron, woollen cloth, as well as transport and agriculture, on national product. Many of these overviews are based on *national* measures.

By contrast, Szostak (1991) argues transport costs played a major role in *spatial redistribution* in the first part of the industrial revolution. Allen (2009) and Clark and Jacks (2007) find that the cost level of pre-industrial coal in London was seven times higher than in Newcastle; Allen points to transport infrastructure being better in the Northern Counties. In pre-industrial society consumption and production was bundled spatially due to high transport

costs and this resulted in relatively little internal trade. The main result of improved transport was lower costs and thus a higher local level of specialisation and industrial concentration. A regional analysis – as I provide here - highlights the interplay between regional specialisation, transport, the emergence of new industries and the scaling of production.

Cottrell (1980), Langton (1984) and Hudson (1989) study the intensity and dynamics of spatial dynamics in the first industrial revolution. Hudson's (2011) discussion, in chapter two of *The Cambridge Economic History of Modern Britain*, offers a broad overview on the industrial structure, and of the industrial landscape in England both during proto industrialisation and the industrial revolution. She lists the main industrial areas and their specialization - such as cotton in Lancashire, worsted in Yorkshire and hardware in Birmingham - and highlights why various places in England and Wales were predisposed to become industrial hubs. Jenkins (1973) previously produced accounts of mills and factories for various sectors for 1835 and found that there were 1 330 woollen mills, 345 flax mills, 238 silk mills and 1245 cotton factories at that time.

But until recently a detailed view of the occupational structure of England and Wales before 1851 was not available. Several attempts have been made. Gregory King used tax records and collected data on income and expenditure of English families and assembled social tables for the year 1688. The population was divided into 26 social groups including such titles as lords and knights, but also farmers, labours and merchants. Patrick Colquhoun (1806) refreshed these social tables for the years 1801-1803 and 1812 for England, using the 1801 census, tax surveys and the Survey of Expenditure. The population was divided into 50 professional titles. Three groups comprised labourers. Agricultural labourers come from the primary sector; but his two other groups are defined by their wage and can not be attached to a given sector. The use for historians is therefore limited. Moreover the tables are on a national level and do not reveal details about regions or counties.

Lindert and Williamson (1980) were among the first to use parish registers for the purpose of quantifying occupational structure in the eighteenth and early nineteenth centuries. They looked at a sample from 1766 to 1814, but also at 26 local censuses compiled by vicars and estate overseers. Their figures (national tables) point to a drift away from agriculture into building and manufacturing from the second half of the eighteenth century. Their relatively small sample does not include female labour, so it can be questioned whether their tables allow for a correct picture of society.

Recent articles present a new direction of analysis but building on the tradition of Lindert and Williamson. A new look at parish registers has allowed for the elaboration of much more detailed data, both sectorally and spatially, by the Cambridge Group for the History of Population and Social Structure (led by Wrigley and Shaw-Taylor). By counting paternal occupations registered in baptismal records between 1813 and 1820 for parishes in England and Wales, and leaning on the 1851 census, they have been able to construct much more detailed and quantifiable statistical estimates on a parish basis for 55 primary, secondary and tertiary male occupations. Their work has similar challenges to Colquhoun. A significant portion of persons have registered themselves in the parish registers as labourers and it can thus be questioned if their statistical techniques to allocate this large group into sectors actually produces adequate tables. Trew (2014) uses their tables to introduce a spatial model to predict agricultural and manufacturing employment for the English regions between 1710 and 1861. But his empirical analysis can only be as reliable as their data.

This paper adds several novelties. The data come from local trade directories - until now, an unused source. This is interesting for several reasons. The data are very different

from baptismal records. Trade directories list professional populations of towns and villages in England and Wales between 1793 and 1798. Both women and men are included and the lists do not focus on a certain age group (such as those of marriageable age) or congregation (Anglican). They also allow us to produce tables twenty years earlier than those previously available. This permits occupational flow analysis for the early industrial revolution. Finally, and given the compelling structure and detail of our main data source, this has enabled us to structure tables for each of the 45 counties into 369 professions and 17 classes, following the same setup as the 1851 census. This allows for a much higher level of detail than previously possible.

2. Methodology. This paper creates a regionalized synthetic census for England and Wales in 1801 and examines tendencies in the regional occupational structure between 1801 and 1851. Brunt and Meidell (2015, chapters one and two) have shown that it is possible to generate a national synthetic census for England and Wales for 1801 based on contemporary data. For this paper I refine that methodology in order to construct occupational census tables for each of the 45 English and Welsh counties. A sketch of the procedure is reproduced in table one below. The correlation between population tables from the 1851 census and contemporary trade directories suggests that trade directories give a good estimate of the occupational distribution for a population. We then apply this approach to the 1801 trade directory.

Table 1. Data sources needed to structure a synthetic census table for 1801.

1801	1851
?	Occupational census
Trade directory	Trade directory

For 1851, a comprehensive and detailed census lists all occupations by county. The national census table includes more than a thousand occupations. In the county structure, the 1851 census aggregated workers into 369 occupations, organized into 17 classes and 90 sub-classes. Each class consist of several sub-classes. For example Class XIII comprises “Persons working and dealing in Matters derived from the Vegetable Kingdom”. Sub-class 12 includes persons “In Flax, Cotton”, and it is completed of the following 11 occupations: *flax and linen manufacture, thread manufacture, weaver (material not stated), draper, lace manufacture, cotton manufacture, lint manufacture, fustian manufacture, muslin embroiderer, calico and cotton printer, other workers in flax and cotton.*

The 1851 census is not structured according to a primary, secondary, tertiary schema. Its 17 classes reflect sectors. For example: *national/local government, defence, learned professions, engaged about animals, conveyance, working the land, mechanic production, and minerals.* Instead of translating the occupations according to a PST classification, such as described in Wrigley (2010), we choose to maintain the 1851 structure. This allows a direct comparison between the 1851 census and our 1801 estimates. It also allows for a better insight into sector activities. We feel that many studies are unclear on the definitional issue of PST versus activity. When one discusses the importance of cotton for England in the early 19th century, does one point to cotton manufacture (PST) or activities in the cotton sector (manufacture, trading and other)?

The Population Act of 1800 enabled the first census for England, Scotland and Wales to be taken. The census was undertaken in 1801 and every ten years thereafter. Mainly the Overseers of the Poor, starting on 10th of March 1801, collected census information in

England and Wales on a parish basis. They knocked on the door of each household to collect answers to the census questions. Professional status was thereby collected for families (rather than persons). The third question in the questionnaire is of particular interest. It concerned the occupation and people were asked "What number of persons, are chiefly employed in Agriculture; how many in Trade, Manufactures, or Handicraft; and, how many are not comprised in any of the preceding Classes?" This division into occupations is insufficient to allow a detailed analysis of occupational change. During the censuses of 1811, 1821 and 1831 the detail was enhanced. The 1821 census measured the age of the population; 1831 added industrial classifications of agriculture, manufacture, making machinery, retail trade, handicraft, merchants, bankers, miners, fishermen and other professions. The level of detail, however, still did not allow for a detailed analysis of occupational change. In 1841 there was a significant improvement in quality; more professions were added and census teams replaced local overseers, schoolmasters and clergy for the data collection. The level of detail was improved further in the 1851 census, which really turned out to be a highpoint in data collection in the history of census, as detail actually fell thereafter.

The first step in estimating the 1801 county census consisted of fixing the county populations. The 1801 census itself estimated the total population of England and Wales to be 8.872.980 million, not including military personnel, seamen and convicts. The population is split into counties and this is our starting point. The next step was to find the number of military personnel, seamen and convicts, which was large in 1801. Parliamentary inquiries give detailed information about defence and seamen. For convicts we lean towards Howard's prison census from 1776. We do not have any reason to believe that the prison population changed significantly to 1801, so the numbers are simply added. Our estimates of these occupations (we discuss below how we found them) sums up to 290.087 persons. Adding these gives a total population of 9.163.067 for England and Wales in 1801.

The next step consisted of deciding how best to estimate the number of persons for each of the 369 occupations in the 1851 county census. Each occupation is attributed to a category based on the data source or method used to estimate the number of workers. Six rules are set up, one for each category. Rule 1 is the simplest. There are five occupations in the 1851 census which did not exist in 1801, or existed with a negligible number of occupants; these are activities connected with the railway. Hence the estimate for 1801 is nil for each occupation. Rule 2 incorporates occupations for which we have access to detailed historical sources. Governmental activities including customs, Inland Revenue, police, military and the navy, fishermen and miners are among the 26 professions listed. The main sources are parliamentary enquiries and reports from 1801 or thereabouts, which give either a detailed list of the incumbents or sufficient information to make an educated guess, both with regards to the total and the county distribution. Rule 3 is slightly more complicated. Thirteen of the activities, and a substantial amount of population, are in the farming sector. The main source is a survey of 400 farms in *c.* 1770 prepared by Arthur Young. The survey estimates the ratios of farm servants, agricultural labourers, boys and maids to farmed acreage. For 1801, we know the total of farmed acreage for each county and we also know the total farming population of England and Wales. The average farm size in 1801 was 146 acres. We use these to estimate the county numbers of these four occupations for 1801. For the other nine occupations, we apply the same ratio of farmer to the occupation as given in the national census for England and Wales for 1851

Rule 4 covers 169 occupations, the largest number of activities, and is thus central to the paper. Most of the occupations of historical interest are included here, such as cotton,

weavers, iron manufacture and woollen cloth, just to name a few. We use the Universal British Directory as our main source. The seven-volume UBD is a comprehensive collection of people's profession compiled between 1793 and 1797 for English and Welsh cities, towns and villages. The trade directory was compiled by private entrepreneurs and sold as a register, akin to today's *Yellow Pages*. The London printers John Wilkes and Peter Barfoot, having received a royal patent in 1790¹, started the organizational work by releasing a comprehensive collection of business information from their *British Directory Office* in London. *The Universal British Directory of Trade, Commerce and Manufacture* list the businesses and principal inhabitants of London and most other cities, towns and important villages in England and Wales. The reader could look up a town and would find all relevant information, including inhabitants and their professional titles.

Rule 5 contains occupations for which no sources give satisfactory data. Of the 150 occupations present, 64 belong to the category "other" (such as *other Teachers*). Each group within each class of the 1851 county census has an occupational title of this type. This was an approach chosen by the census authors to reduce the number of occupations from 1091 to 369, by summing up rare occupations for each group within each category. The best we can do for these is to assume that the ratio to the county population in 1801 is the same as the ratio to the county population in 1851. Obviously, these occupations are numerally unimportant – which is exactly why they were aggregated.

Finally we have five occupations where the number depends on that of another occupation. For example, we take the number of butcher's wives as a proportion of the number of butchers. For these we apply the same ratio between the two as in the 1851 county census.

When adding up the total number of persons for all 169 occupations of Rule 4 (the UBD) over all cities and towns (some of which are weighted), we seldom exactly match a given county population from the 1801 census. In order to match a county population exactly we therefore rescale the number of persons for Rule 4 in the following way. We subtract the number of persons given under Rule 2, 3, 5 and 6 from the 1801 county total. We then rescale the total number calculated under rule two, to match the residual population. This way, we maintain the distribution and arrive at the exact county population.

The next two sections report important clusters in 1801, and notable developments between 1801 and 1851 on a county and industrial level. Not all the 17 classes in the census, and not all the occupations are discussed. We focus on those of significant economic historical interest. There were noticeable changes in the government of counties and the country, family structures changed and the prison population was relatively reduced. However none of these are central to our research questions. In the following discussion, and for the classes we believe are of interest to the economic historian, we first discuss county concentrations in 1801, followed by a description of the changes to 1851. When working our way through the classes and reporting the numbers we found, we instinctively stopped regularly and wondered about the story behind the numbers. Any "bump" in the number has a historical backstory which is of interest in itself and acts as a qualitative check on the quantitative work. However, with 369 occupations this paper could quickly develop into an entire book on the industrial revolution. So in order to keep the paper as precise and focused as possible, we report the numbers and only connect our story loosely to important historical events.

¹ [https://en.wikipedia.org/wiki/John_Wilkes_\(printer\)](https://en.wikipedia.org/wiki/John_Wilkes_(printer))

3. County specialization. 1801 was a year in which England and Wales were marked by the Napoleonic wars. The Class in the 1801 census “Persons Engaged in the Defence of the Country” represented a significant part of the population at the time. 179 226 men were engaged in the defence of the country; 54 559 of these were stationed in Hampshire, equivalent to 19.6% of the county population. Of these, 25 922 were seamen in the Royal Navy, 21 095 soldiers and 5 098 Marines. Kent was not far behind and had 47 934 enlisted men, 13.4% of the population. London is number three with 24 028 persons, although many of these were Greenwich and Chelsea pensioners. Essex (11 678), Sussex (11 307) and Devonshire (7 962) all had important deployments. Twelve counties had soldiers being more than 1% of the population, many in the south and southeast. In 1851, war was far away and defence less prioritized. Military employment had been reduced drastically. The highest number of people registered for defence was found in London, with 19 547, an impressive reduction in forces compared to 50 years earlier.

“Persons engaged in the Conveyance of Men/Woman, Animals, Goods and Messages” aggregate occupations transporting goods and people. Transport links and transportation costs are central to the dynamics of the industrial revolution as more efficient, quicker and cheaper transport brings together suppliers, manufacturers and customers. In 1801, 227 294 persons (2.48% of the population) engaged in conveyance; 54% of these were seamen in the merchant service. Two regions stick out for transport in 1801. 55 588 transport workers were active in London, 18 382 in Kent, 8 299 in Hampshire and 7 239 in Essex. In the north, 26 800 were engaged in conveyance in Lancashire, 13 354 more in Durham. Many seamen came, not unsurprisingly, from coastal counties in addition to London. The capital had 19 703 seamen in 1801. Inhabitants from both Lancashire (17 992) and Durham (12 497) worked on ships out of Liverpool and Newcastle. Car men, boatmen and messengers served the interior transport network of the country. London had the largest accumulation of car men by far, with 7 396 in 1801. Boatmen were also concentrated in and around London.

The total volume of transport rose in the fifty years following 1801. But higher efficiency in transportation, driven by the expanding railway system, reduced the relative general demand for personnel such that in 1851, only 1.9% of the population engaged in conveyance. But the regional change is more interesting. The five counties with the highest part of population engaged in transport in 1801 experienced a reduction of 30% to 70% to 1851. Durham for example had 8.1% of the population occupied in transport in 1801. The workforce share was reduced to 3.2% by 1851. London, Kent, Northumberland and East Yorkshire experienced equally strong contractions in personnel as a proportion of the total. The national tendency is distinctly towards a fairly equal distribution. Both the industrial counties in the north (with the exception of West Yorkshire) and London experienced a relative reduction in transport workers as a fraction of their populations. At the same time, counties north of London and the Midlands experienced marked growth. Most of these counties had their workforce in transport doubling to quadrupling. This is the imprint of industrial development and signals the importance of conveyance. The transport system allowed spatial specialisation. In 1836 and 1845-47, Parliament authorized 8 000 miles of railway lines. More than 1 000 projects were competing for new railway charters after the early railway lines paid good dividends. The lines connected London, the Midlands and the north and allowed an unheard of improvement in transportation time.

The agrarian sector in 1801 was clearly the most populous. A total of 1 561 131 persons were active in working the land and keeping animals. In the average county, the

occupation comprised 17.0% of the total population at the time, with agricultural labourers followed by farm servants (indoor) as the most frequent professions. Obviously it was a much higher percentage of the *working* population. A few exceptions to this high level are noteworthy. In London, not surprisingly, only 1.3% of all the population engaged in farming; Middlesex (11.0%) was much higher than London but the third lowest level of the counties; Lancashire had large urban areas with much manufacturing and less farming (10.8% of its population). The Welsh counties and Monmouthshire was a region with a high ratio of farmers. South Wales is the county with the largest headcount (90 145 persons were engaged in agriculture, 30.71% of the county population). Cambridgeshire (31.25%) and Lincolnshire (30.75%) had even higher ratios.

The evolution from 1801 to 1851 followed the general trend observed for other sectors. Regional and county specialisation went up, facilitated by improved and cheaper transport, permitting increased distance to the final consumer. Regionally, it is almost as if we can see a dichotomous development. Certain counties specialize in farming, whereas others attract more labour to expanding manufacturing sectors, such as cotton and iron. The counties surrounding London and towards the Welsh border maintained their headcount in farming; Wiltshire, Hertfordshire and Buckinghamshire increased the absolute number active in agricultural activities. Herefordshire increased its farming sector by an astonishing 41%. Herefordshire was the county with the highest ratio in farming, 23.3% in 1851, up from 16.5% in 1801. Other counties with a share of more than 20.0% in 1851 were Lincolnshire (20.4%), Rutlandshire (22.0%), Huntingdonshire (21.6%), Wiltshire (21.4%), North Yorkshire (21.6%), Westmorland (22.6%) and North Wales (22.2%). The urban centres increased activities in industrial and tertiary sectors at the cost of agriculture; this opened opportunities for both surrounding counties and counties further away (given improved transport) to grow their agriculture and specialize in it.

Given the strong focus on mechanisation and improved design, one would expect the activity level in both arts and mechanical production to pick up on a broad level. This was indeed the case. On a national level the fraction rose from 1.6% in 1801 to 3.7% in 1851. This class has many occupations (48) covering key functions. Its 17 subclasses include: *In Books, In Plays, In Music, In Pictures and Engravings, In Carving and Figures, In Shows and Game, In Plans and Designs, In Medals and Discs, In Watches and Philosophical Instruments, In Arms, In Machines, In Carriages, In Harness, In Ships, In Houses, In Implements* and finally *In Chemicals*. This is the class of culture, builders and engineers – those who make the industrial revolution possible by bringing inventions, constructing factories, bridges, canals, roads, railways and boats, by building mechanical devices from watches to arms and Spinning Jennies. The wheelwrights and millwrights are all here, but also the printers, the artists and the musicians. Much neglected in literature, perhaps because measuring output is not easy, it nevertheless is the nerve centre of development already underway in 1801 and which continued towards 1851.

In 1801, a total of 149 065 persons were engaged in these forms of activity. London and the surrounding region was the power centre. The most numerous workers were in house construction: carpenters, joiners, brick makers, masons and paviors totalled 74 693 persons in 1801. Perhaps not unsurprisingly, London had the smallest employment proportion amongst the counties (0.04%) and Middlesex the highest (2.0%) followed by Buckinghamshire (2.0%). The city was too expensive for workers to live in with modest salaries, so they settled close by. In Lancashire and West Yorkshire, however, the number of such workers were still modest in 1801 – but this was about to change. Over the next fifty years, the activity level

exploded. By 1851 the number of occupants of this class had grown to an impressive 664 079 (3.70%). Builders facilitated the growth of the country. The number of builders for example went up a six-fold, printers and musicians five-fold, engravers eight-fold, instrument makers four-fold, watchmakers and carpenters doubled, and so the list continues. More than any other, the changes observed in this class are perhaps the best imprint of a growing society becoming industrialized and richer. Certain regional trends are also evident. The northern counties had the most explosive growth. Lancashire and West Yorkshire both increased the work force to more than four times the level of 1801, whereas total population only doubled. London and surrounding regions, on the other hand, enjoyed lower than average growth rates. The mining areas of North and South Wales expanded; 24 000 additional builders, carpenters and engineers were engaged up to 1851.

The class of “Persons working and dealing in Animal Matters” does not include occupations about raising animals (agriculture), but is rather a collection of all activities undertaken with the various parts of animals afterwards. Butchers, fishmongers, tallow chandlers, curriers, tanners and, of particular interest, activities connected with woollen cloth manufacture and trade. 38% of the persons in this class were engaged in woollen cloth manufacture, the eleventh most populous profession in 1801. Woollen cloth manufacture was overall one of the most important industrial occupational groups in 1801, with 103 730 incumbents representing a total of 1.13% of the national population. In Devonshire, 6.3% of the population (22 626 workers) were active producing woollen clothing. This was the largest cluster of workers in the country. Lancashire was number two with 2.7% of the population (18 345 workers). Wiltshire had 13 411 persons engaged in this sector. Sizable outputs were also achieved in West Yorkshire (9 690 people, 1.7% of the population), London (5 270 people) and Oxfordshire (6 136 people), Somersetshire (7 166 people). In 19 counties, woollen cloth manufacture was a central and important activity for the local economy. During the next fifty years, the regional production pattern changed remarkably. Nationally, 18 526 more workers were active, which reduced the proportion of the population to 0.7%. Many counties, especially those which were not among the biggest producers but which still had important producers experienced a collapse. In East Yorkshire, Warwickshire, Staffordshire, Shropshire, Rutlandshire, Norfolk, London, Oxfordshire, Lincolnshire, Durham and Leicestershire, production halted almost completely. The former stronghold of Devonshire saw its workforce decrease from 22 625 to 2 818 workers. The big winner was West Yorkshire, where the woollen cloth workforce went from 9 690 to an impressive 81 124 workers. The only two counties retaining important production outside West Yorkshire in the mid-19th century was Wiltshire (where the workforce remained unchanged) and Lancashire (which nonetheless had a reduction from 18 345 to 10 999). In 1801, 17 counties employed more than 1 000 wool workers; by 1851, it fell to eight. New counties also came along. Gloucestershire went from no production to 2.1%. A similar story, though on a much smaller scale, can be shown for North and South Wales.

The story is similar for worsted manufacture, clothiers and stuff manufacture. Worsteds manufacture on a national basis grew towards 1851. As with woollen cloth manufacture West Yorkshire specialised in worsteds at the cost of most other counties, especially Leicestershire, which had been the centre fifty years earlier, with 4 273 workers (3.2% of its population).

Class XIII of the census contains several occupations of special interest to the economic historian. It includes 61 activities of persons working and dealing in matters derived from the vegetable kingdom. This does not include farmers. Rather, it focuses on trading and elaboration of raw materials, and thus to a large part on secondary and tertiary sector

engagements. Cotton manufacture and trading constituted a key part of the development of England and Wales at this time. How was this sector structured in 1801? Cotton manufacture was already established as an important activity in England (less in Wales). Lancashire was already largely ahead of any other county with 69 194 workers (9.1%). However, high activity could also be found in Cheshire (16 850), West Yorkshire (15 481), Hertfordshire (9 103), Nottinghamshire (7 760) and Derbyshire (6 628). By 1851, cotton manufacture had become even more specialized in the north, with 287 076 persons being active in Lancashire in addition to the surrounding counties of Derbyshire (13 482), Cumberland (7 832), Cheshire (29 474) and West Yorkshire (24 220). Earlier centres that were significant in 1801, such as Staffordshire, Warwickshire, Nottinghamshire and Hertfordshire, had given up and only a few smaller, scattered manufacturing sites could be found. Thus 77.2% of the people engaged in this activity in 1851 were found in Lancashire alone, up from 45.1% fifty years earlier.

Flax and linen manufacture collapsed towards 1851. Out of 192 969 active workers in 1801, only 26 325 remained active in 1851. In 1801 this was the fourth most populous activity with 2.1% of the total population engaged. Staffordshire had 11 297 active manufacturers, falling to 56 by 1851. Flax and linen manufacture was a widespread activity 1801 and could be found in most counties. Particularly important clusters could be found in Yorkshire (42 479) and Norfolk (26 501), but also Dorsetshire, Huntingdonshire, Herefordshire, North Wales, Staffordshire, Suffolk and Worcestershire. They all had 3-7% of their population active in this occupation. By 1851 only West Yorkshire (16 898 persons) and Lancashire (2 132) had significant activity.

Thread manufacture follows a similar pattern, but the reduction here is even more impressive. Out of 23 385 active workers in 1801 (spread out over the country), only 842 were still active in 1851! New products, new technology and higher efficiency made the workforce redundant. Weavers were likewise overtaken by machines and disappeared as a profession in most counties. In 1801 weaving was largely a home activity spread out over the whole country, with the exception of the southwestern counties. Even in London, weaving constituted a most important occupation in 1801 with 50 350 (5.9%) being weavers. Impressive drops were to be seen in Westmorland (where 3 466 weavers in 1801 - 8.15% - went to nil in 1851) and in Kent (where 1 029 weavers went to three in 1851). The tendency in fustian manufacture followed the same pattern. In 1801, 22 626 workers were engaged in lint production. Lint manufacture was centred in Lancashire already in 1801, with 89.1%. By 1851, only 5 505 remained - almost all in Lancashire.

The relative number of people engaged in matters from the animal kingdom was reduced by 32% between 1801 and 1851. In 1801, 813 304 persons engaged in these activities (8.9% of the total national population). By 1851, 265 279 more were active, but this translates to only 6% of the total population in total.

Class XIV in the 1851 census is dedicated to “Persons working and dealing in minerals”. All mining activities are included here (coal, copper, tin, lead, iron). Unlike other sectors, this class includes occupations from primary, secondary and tertiary activities. In 1801 this class constituted a significant part of national activity with 2.8% of the population (257 017 persons). Given the large range of occupations included (55) - including such common jobs such as blacksmith, brazier, tin man and coal heaver - the class was sizeable in all counties. A closer look at individual occupations, however, reveals notable differences. In 1801, we estimate that there were 72 590 persons engaged in coal mining. Coal miners were active in 15 counties, with the biggest settlements in South Wales (11 333 miners), Lancashire (9 333), Staffordshire (8 772 miners), Durham (8 184 miners) and Northumberland (8 184

miners). By 1851, the number of miners had increased to 185 924 (an increase from 0.8% to 1.0% of the population). Lancashire and Durham both had more than 28 000 persons engaged as coal miners. Bordering counties (West Yorkshire, Staffordshire, Derbyshire and even Leicestershire) also had important contingents. The other significant regions in 1851 were South Wales and, to a smaller extent North Wales; both employed roughly 25 000 miners (up from 12 333 miners in 1801).

Iron mining, manufacturing and trading was fundamental to industrialization and especially to the massive expansion in railway construction from the 1840's. Occupations in iron manufacturing and trading display a fascinating picture and confirm the strong development of England and Wales. In Monmouthshire, from 1801 to 1851, the number of persons engaged in iron manufacture went up fourteen times, in Cumberland by nine times, in Worcestershire seven times. In Lincolnshire, Rutlandshire, North Yorkshire, Shropshire and Cornwall it quadrupled. Not a single county had a decrease in iron manufacture and trading, measured in numbers of employed persons.

At the beginning of the 19th century, roughly 7 300 persons were engaged in iron mining. The important centres (due to the geography of ore) were South Wales (2 673 miners), Monmouthshire (1 249 miners) and Staffordshire (1 064 miners). The total number of iron miners increased to 19 380 in 1851 (only a slight proportional rise from 0.08% to 0.1%). Iron-ore obviously does not move, so the important regions remained the same.

For each of the 369 occupations in the county census of 1801, an interesting story can be told. In this section, we have chosen to focus on the most significant professions and those that are of special interest to understanding the industrial revolution in England and Wales. Three main tendencies are worth summarizing. First, many counties increased their specialisation. This is not unexpected. The novelty here is a more comprehensive and quantitative analysis of the trends, which has been treated in a qualitative manner previously. Examples are Lancashire's focus on cotton manufacture, worsted production in Yorkshire and the higher degree of farming in the north and around London. Second, some activities became dispersed over a range of counties. The prime example is transport. A better and larger network of roads, canals and (eventually) railways was a requirement for a higher level of specialisation. Cheaper, faster and better transport allowed the manufacturers to ship the goods to a wider circle of people, as opposed to the local production as earlier. Third, some activities were reduced or simply vanished. Weaving is a good example. Weaving used to be a cottage industry, but was replaced by much more efficient technology in factories. Table two below gives an overview of the five largest occupations for each county in 1801 and 1851. Class five of the census (wives, sons, daughter and scholars) is omitted in the comparison to give a better view of proper professional activities. The percentages, however, include all 369 occupational titles, as well as those of subclass five (wives, children, scholars).

Table 2. Top five occupations per county.

Bedfordshire	1801		1851
agricultural labourer (outdoor)	18.80%	agricultural labourer (outdoor)	13.62%
straw plait manufacture	4.09%	straw plait manufacture	7.79%
straw hat, bonnet, -maker	2.54%	lace manufacture	4.46%
farm servant (indoor)	2.35%	straw hat, bonnet, -maker	3.93%
farmer	1.77%	domestic servant (general)	2.09%

Berkshire	1801		1851
agricultural labourer (outdoor)	17.00%	agricultural labourer (outdoor)	13.54%
farm servant (indoor)	2.95%	domestic servant (general)	4.06%
domestic servant (general)	2.14%	labourer (branch undefined)	2.13%
cotton manufacture	1.87%	farm servant (indoor)	1.74%
labourer (branch undefined)	1.50%	shoemaker, bootmaker	1.19%
Buckinghamshire	1801		1851
agricultural labourer (outdoor)	11.91%	agricultural labourer (outdoor)	12.91%
lace manufacture	3.23%	lace manufacture	7.33%
farm servant (indoor)	2.32%	domestic servant (general)	2.62%
bricklayer	2.01%	straw plait manufacture	2.09%
draper	2.00%	labourer (branch undefined)	1.96%
Cambridgeshire	1801		1851
agricultural labourer (outdoor)	20.42%	agricultural labourer (outdoor)	12.69%
Farmer	3.00%	domestic servant (general)	3.26%
farm servant (indoor)	2.39%	farmer	1.78%
domestic servant (general)	1.99%	labourer (branch undefined)	1.76%
labourer (branch undefined)	1.52%	milliner, dressmaker	1.19%
Cheshire	1801		1851
cotton manufacture	8.64%	cotton manufacture	6.94%
agricultural labourer (outdoor)	6.30%	silk manufacture	5.18%
farm servant (indoor)	5.17%	domestic servant (general)	3.75%
Farmer	2.80%	agricultural labourer (outdoor)	3.43%
flax, linen, -manufacture	2.78%	labourer (branch undefined)	2.16%
Cornwall	1801		1851
agricultural labourer (outdoor)	6.63%	copper-miner	5.41%
farm servant (indoor)	4.82%	agricultural labourer (outdoor)	4.60%
Farmer	3.15%	tin-miner	3.43%
copper-miner	2.86%	farm servant (indoor)	3.01%
copper manufacture	2.34%	domestic servant (general)	2.53%
Cumberland	1801		1851
farm servant (indoor)	8.91%	agricultural labourer (outdoor)	4.24%
agricultural labourer (outdoor)	5.98%	farm servant (indoor)	4.03%
Farmer	3.32%	cotton manufacture	4.01%
mechanic, manufacturer, shopman, shopwoman	2.82%	farmer	2.69%
calico, cotton, -printer	2.44%	domestic servant (general)	2.67%
Derbyshire	1801		1851
agricultural labourer (outdoor)	4.16%	cotton manufacture	5.17%
cotton manufacture	4.04%	agricultural labourer (outdoor)	3.11%
mechanic, manufacturer, shopman, shopwoman	3.85%	farmer's, grazier's son, grandson, brother, nephew	2.28%
flax, linen, -manufacture	3.76%	domestic servant (general)	2.27%

earthenware manufacture	3.53%	silk manufacture	2.23%
Devonshire	1801		1851
agricultural labourer (outdoor)	7.88%	agricultural labourer (outdoor)	6.03%
woollen cloth manufacture	6.34%	farm servant (indoor)	3.98%
farm servant (indoor)	5.40%	domestic servant (general)	3.94%
Farmer	2.45%	farmer	2.04%
domestic servant (general)	2.09%	milliner, dressmaker	1.96%
Dorsetshire	1801		1851
agricultural labourer (outdoor)	11.64%	agricultural labourer (outdoor)	11.76%
flax, linen, -manufacture	5.76%	domestic servant (general)	3.12%
farm servant (indoor)	1.86%	labourer (branch undefined)	2.34%
Farmer	1.62%	milliner, dressmaker	1.51%
Soldier	1.61%	shoemaker, bootmaker	1.35%
Durham	1801		1851
seaman (merchant service)	7.57%	coal-miner	6.88%
coal-miner	4.96%	domestic servant (general)	2.62%
flax, linen, -manufacture	4.42%	agricultural labourer (outdoor)	2.06%
agricultural labourer (outdoor)	4.39%	seaman (merchant service)	1.87%
weaver (material not stated)	3.97%	labourer (branch undefined)	1.77%
Essex	1801		1851
agricultural labourer (outdoor)	13.48%	agricultural labourer (outdoor)	13.30%
soldier	4.55%	domestic servant (general)	2.78%
draper	3.47%	labourer (branch undefined)	2.00%
farm servant (indoor)	1.84%	farmer	1.29%
farmer	1.37%	farm servant (indoor)	1.12%
Gloucestershire	1801		1851
agricultural labourer (outdoor)	8.01%	agricultural labourer (outdoor)	6.73%
mechanic, manufacturer, shopman, shopwoman	3.24%	domestic servant (general)	5.01%
clothier	3.06%	labourer (branch undefined)	2.68%
domestic servant (general)	2.70%	woollen cloth manufacture	2.09%
flax, linen, -manufacture	2.53%	milliner, dressmaker	1.81%
Hampshire	1801		1851
seaman, r.n.	9.33%	agricultural labourer (outdoor)	8.36%
agricultural labourer (outdoor)	8.60%	domestic servant (general)	4.14%
soldier	7.59%	labourer (branch undefined)	2.21%
seaman (merchant service)	2.16%	soldier	1.26%
marine	1.83%	milliner, dressmaker	1.25%
Herefordshire	1801		1851
weaver (material not stated)	6.77%	agricultural labourer (outdoor)	12.45%
flax, linen, -manufacture	5.65%	domestic servant (general)	4.32%
farm servant (indoor)	3.71%	farm servant (indoor)	3.33%
farmer	2.40%	farmer	2.92%

draper	1.79%	pauper of no stated occupation	1.38%
Huntingdonshire	1801		1851
agricultural labourer (outdoor)	15.60%	agricultural labourer (outdoor)	14.22%
flax, linen, -manufacture	7.53%	domestic servant (general)	2.38%
farm servant (indoor)	2.71%	farm servant (indoor)	1.82%
farmer	2.02%	farmer	1.71%
weaver (material not stated)	1.35%	lace manufacture	1.71%
Kent	1801		1851
agricultural labourer (outdoor)	8.56%	agricultural labourer (outdoor)	8.56%
seaman, r.n.	5.49%	domestic servant (general)	3.92%
weaver (material not stated)	5.36%	labourer (branch undefined)	2.07%
soldier	4.71%	soldier	1.44%
boat and bargeman	2.58%	farm servant (indoor)	1.39%
Lancashire	1801		1851
cotton manufacture	9.10%	cotton manufacture	13.89%
agricultural labourer (outdoor)	3.39%	domestic servant (general)	3.06%
domestic servant (general)	3.03%	labourer (branch undefined)	1.99%
fustian manufacture	2.95%	silk manufacture	1.45%
labourer (branch undefined)	2.71%	coal-miner	1.40%
Leicestershire	1801		1851
agricultural labourer (outdoor)	8.10%	hose (stocking) manufacture	12.81%
hose (stocking) manufacture	8.08%	agricultural labourer (outdoor)	5.80%
worsted manufacture	3.23%	domestic servant (general)	3.10%
farm servant (indoor)	3.13%	farm servant (indoor)	1.86%
flax, linen, -manufacture	2.54%	farmer	1.49%
Lincolnshire	1801		1851
agricultural labourer (outdoor)	14.68%	agricultural labourer (outdoor)	9.93%
farm servant (indoor)	5.88%	domestic servant (general)	4.46%
farmer	3.89%	farm servant (indoor)	2.91%
flax, linen, -manufacture	3.43%	farmer	2.74%
weaver (material not stated)	1.98%	labourer (branch undefined)	1.44%
London	1801		1851
weaver (material not stated)	5.90%	domestic servant (general)	6.07%
domestic servant (general)	5.82%	labourer (branch undefined)	2.17%
labourer (branch undefined)	2.64%	shoemaker, bootmaker	1.63%
Chelsea pensioner	2.49%	laundry-keeper, mangler	1.56%
seaman (merchant service)	2.31%	messenger, porter (not government), errand-boy	1.43%
Middlesex	1801		1851
agricultural labourer (outdoor)	6.69%	agricultural labourer (outdoor)	6.01%
bricklayer	2.91%	domestic servant (general)	5.33%
domestic servant (general)	2.63%	labourer (branch undefined)	2.96%
carpenter, joiner	1.99%	gardener	2.00%

labourer (branch undefined)	1.92%	laundry-keeper, mangler	1.50%
Monmouthshire	1801		1851
farm servant (indoor)	8.59%	coal-miner	6.64%
agricultural labourer (outdoor)	8.57%	iron, manufacturer, moulder, founder	3.73%
labourer (branch undefined)	4.94%	labourer (branch undefined)	3.49%
farmer	3.85%	agricultural labourer (outdoor)	3.14%
seaman (merchant service)	3.26%	domestic servant (general)	2.49%
Norfolk	1801		1851
agricultural labourer (outdoor)	12.68%	agricultural labourer (outdoor)	4.97%
flax, linen, -manufacture	9.51%	domestic servant (general)	2.89%
farm servant (indoor)	2.36%	shoemaker, bootmaker	2.16%
farmer	1.88%	milliner, dressmaker	1.75%
carpet, rug, -manufacture	1.62%	farmer	1.67%
North Wales	1801		1851
farm servant (indoor)	11.27%	farm servant (indoor)	6.38%
agricultural labourer (outdoor)	5.86%	farmer	4.27%
farmer	5.06%	agricultural labourer (outdoor)	4.25%
flax, linen, -manufacture	4.18%	domestic servant (general)	2.69%
farmer's, grazier's son, grandson, brother, nephew	2.69%	farmer's, grazier's son, grandson, brother, nephew	2.12%
Northamptonshire	1801		1851
agricultural labourer (outdoor)	12.49%	agricultural labourer (outdoor)	10.27%
mechanic, manufacturer, shopman, shopwoman	12.14%	shoemaker, bootmaker	6.40%
farm servant (indoor)	2.66%	lace manufacture	5.00%
soldier	1.96%	domestic servant (general)	2.45%
lace manufacture	1.83%	farm servant (indoor)	1.67%
Northumberland	1801		1851
agricultural labourer (outdoor)	6.86%	agricultural labourer (outdoor)	4.93%
laundry-keeper, mangler	5.98%	coal-miner	3.51%
coal-miner	5.06%	domestic servant (general)	3.47%
seaman (merchant service)	4.78%	labourer (branch undefined)	1.87%
farm servant (indoor)	3.63%	farm servant (indoor)	1.41%
Nottinghamshire	1801		1851
hose (stocking) manufacture	5.94%	hose (stocking) manufacture	7.55%
cotton manufacture	5.44%	lace manufacture	5.31%
farm servant (indoor)	3.85%	agricultural labourer (outdoor)	5.06%
flax, linen, -manufacture	3.50%	domestic servant (general)	2.71%
farmer	2.28%	farm servant (indoor)	2.30%
Oxfordshire	1801		1851
agricultural labourer (outdoor)	13.77%	agricultural labourer (outdoor)	12.84%
woollen cloth manufacture	5.48%	domestic servant (general)	3.58%
mechanic, manufacturer, shopman,	2.93%	labourer (branch undefined)	1.66%

shopwoman			
farm servant (indoor)	2.29%	farm servant (indoor)	1.46%
flax, linen, -manufacture	1.71%	farmer	1.43%
Rutlandshire	1801		1851
agricultural labourer (outdoor)	11.19%	agricultural labourer (outdoor)	11.61%
woollen cloth manufacture	9.44%	domestic servant (general)	4.62%
flax, linen, -manufacture	3.93%	farmer	2.66%
farmer	2.97%	labourer (branch undefined)	1.82%
farm servant (indoor)	2.10%	farm servant (indoor)	1.67%
Shropshire	1801		1851
agricultural labourer (outdoor)	9.38%	agricultural labourer (outdoor)	7.85%
farm servant (indoor)	6.16%	domestic servant (general)	4.45%
coal-miner	3.51%	farm servant (indoor)	3.90%
flax, linen, -manufacture	2.61%	farmer	2.21%
farmer	2.38%	coal-miner	2.12%
Somersetshire	1801		1851
agricultural labourer (outdoor)	9.72%	agricultural labourer (outdoor)	8.13%
farm servant (indoor)	2.98%	domestic servant (general)	3.80%
woollen cloth manufacture	2.57%	labourer (branch undefined)	2.35%
farmer	2.28%	glover (material not stated)	2.02%
domestic servant (general)	2.08%	farm servant (indoor)	1.86%
South Wales	1801		1851
farm servant (indoor)	11.46%	farm servant (indoor)	5.02%
farmer	5.27%	coal-miner	3.42%
agricultural labourer (outdoor)	5.16%	farmer	3.38%
coal-miner	3.86%	agricultural labourer (outdoor)	2.86%
seaman (merchant service)	2.97%	labourer (branch undefined)	2.79%
Staffordshire	1801		1851
flax, linen, -manufacture	4.65%	coal-miner	4.20%
coal-miner	3.61%	earthenware manufacture	4.00%
farm servant (indoor)	3.12%	domestic servant (general)	3.03%
labourer (branch undefined)	2.36%	agricultural labourer (outdoor)	3.03%
farmer	2.02%	labourer (branch undefined)	2.17%
Suffolk	1801		1851
agricultural labourer (outdoor)	14.50%	agricultural labourer (outdoor)	12.70%
flax, linen, -manufacture	4.16%	domestic servant (general)	2.52%
farm servant (indoor)	3.31%	farmer	1.68%
farmer	1.96%	shoemaker, bootmaker	1.31%
draper	1.24%	milliner, dressmaker	1.20%
Surrey	1801		1851
agricultural labourer (outdoor)	10.17%	agricultural labourer (outdoor)	9.18%
laundry-keeper, mangler	7.83%	domestic servant (general)	5.17%
domestic servant (general)	2.50%	labourer (branch undefined)	2.34%

farm servant (indoor)	1.84%	gardener	1.43%
draper	1.48%	laundry-keeper, mangler	1.17%
Sussex	1801		1851
agricultural labourer (outdoor)	14.11%	agricultural labourer (outdoor)	10.17%
soldier	6.17%	domestic servant (general)	4.53%
farm servant (indoor)	3.02%	labourer (branch undefined)	1.56%
domestic servant (general)	2.69%	farm servant (indoor)	1.39%
draper	2.67%	milliner, dressmaker	1.26%
Warwickshire	1801		1851
agricultural labourer (outdoor)	7.45%	agricultural labourer (outdoor)	4.26%
mechanic, manufacturer, shopman, shopwoman	5.29%	domestic servant (general)	3.89%
flax, linen, -manufacture	2.36%	silk manufacture	2.80%
domestic servant (general)	2.27%	ribbon manufacture	1.94%
farm servant (indoor)	2.17%	tailor	1.82%
Westmorland	1801		1851
farm servant (indoor)	8.79%	farm servant (indoor)	5.23%
weaver (material not stated)	8.16%	farmer	4.36%
farmer	4.53%	agricultural labourer (outdoor)	4.21%
woollen cloth manufacture	2.90%	domestic servant (general)	3.29%
flax, linen, -manufacture	1.82%	woollen cloth manufacture	1.65%
Wiltshire	1801		1851
agricultural labourer (outdoor)	13.53%	agricultural labourer (outdoor)	15.13%
woollen cloth manufacture	7.11%	woollen cloth manufacture	4.99%
clothier	4.97%	domestic servant (general)	2.83%
mechanic, manufacturer, shopman, shopwoman	3.80%	labourer (branch undefined)	1.96%
farm servant (indoor)	2.05%	farm servant (indoor)	1.37%
Worcestershire	1801		1851
agricultural labourer (outdoor)	8.33%	agricultural labourer (outdoor)	5.93%
flax, linen, -manufacture	4.43%	domestic servant (general)	4.30%
carpet, rug, -manufacture	3.81%	nail manufacture	3.68%
laundry-keeper, mangler	2.42%	labourer (branch undefined)	2.26%
domestic servant (general)	2.22%	glover (material not stated)	1.88%
Yorkshire, east	1801		1851
agricultural labourer (outdoor)	7.04%	agricultural labourer (outdoor)	4.56%
farm servant (indoor)	6.05%	domestic servant (general)	4.10%
flax, linen, -manufacture	5.13%	labourer (branch undefined)	3.49%
seaman (merchant service)	3.21%	farm servant (indoor)	3.28%
farmer	2.37%	farmer	1.75%
Yorkshire, north	1801		1851
flax, linen, -manufacture	7.63%	agricultural labourer (outdoor)	6.70%
weaver (material not stated)	7.60%	farm servant (indoor)	4.15%

agricultural labourer (outdoor)	7.11%	domestic servant (general)	4.10%
farm servant (indoor)	5.27%	farmer	3.82%
farmer	3.54%	shoemaker, bootmaker	1.53%
Yorkshire, west	1801		1851
mechanic, manufacturer, shopman, shopwoman	12.70%	worsted manufacture	7.25%
agricultural labourer (outdoor)	4.22%	woollen cloth manufacture	6.05%
flax, linen, -manufacture	4.01%	agricultural labourer (outdoor)	2.17%
cotton manufacture	2.70%	domestic servant (general)	2.06%
Farmer	2.40%	cotton manufacture	1.81%

Source: own calculations.

A categorisation of professions into three classes (primary, secondary and tertiary) is a frequently used approach and has become standard in discussions of the evolution of the industrial revolution. Our discussion however, has used the groupings defined in the 1851 census. These concentrate on sectors and less on the type of activity according to a PST scheme. Most of the classes in the census therefore include professions from all three types, primary, secondary and tertiary. Class fourteen in the census is a good example. It includes miners (primary), manufacturers using the minerals (secondary) and those trading in such (tertiary). There are several advantages to following the census structure rather than a PST scheme. It is easier both to characterize and trace over time the occupational changes by using an existing setup. Also, the present view allows a better view of sectoral activities and the importance of cotton and iron for the economy (as opposed to simply cotton manufacture and iron manufacture). Nonetheless, in order to facilitate a comparison with the PST schema, we have also formulated our findings accordingly. In our data from UBD and our other sources, variations in titles for a given professional occurred. In order to code these we consulted with the occupational coding system prepared by Wrigley and Davies.² Table four in the annex shows our findings for the 45 English and Wales counties for 1801 and for 1851. The column to the right shows the flow, or the change in these groups over the time period.

Here I just summarize the key points. Herefordshire experienced a strong specialisation in the primary sector from 1801 to 1851, with the primary sector increasing from 33% to 49%. Buckinghamshire, Hertfordshire, Essex and Hampshire, all in the orbit of London, also experienced significant increases because the capital needed more food. However, most counties saw the proportion of workers in the primary sector fall. The most impressive reductions were in South Wales (-25.5%), Bedfordshire (-21.0%), Monmouthshire (-24.9%), Cambridgeshire (-18.2%), Cheshire (-18.2%), Lincolnshire (-16.6%), Cumberland (-14.2%) and Lancashire (-13.9%).

The relative change in secondary sector employment from 1801 to 1851 varies noticeably between counties. Only 17 of the 45 counties had a relative increase in the secondary sector working population. Industrialization in England and Wales was not general, but rather led to a higher level of local specialization (whether into primary, secondary or tertiary sector occupations). The counties with the largest growth in the secondary sector were Monmouthshire (23.7%), South Wales (20.1%), Bedfordshire (19.2%), Northumberland (15.1%) and Lancashire (12.5%). Not surprisingly, Herefordshire saw the biggest contraction

² <http://www.geog.cam.ac.uk/research/projects/occupations/britain19c/pst.html>

in secondary activities (-21.4%), but Middlesex (-13.8%), Rutlandshire (-15.0%), Wiltshire (-14.8%) and North Yorkshire (-14.4%) all experienced significantly lower activity in manufacturing and other secondary professions.

In a range of counties we observe a switch from primary to tertiary sector activities. Good examples are Westmorland (-4.8%,+11.4%), Worcestershire (-6.4%,+6.2%), West Yorkshire (-11.0%,+7.3%), Somersetshire (-7.2%,+5.5%), Shropshire (-6.5%,+10.4%), North Wales (-10.0%,+8.1%), Nottinghamshire (-9.4%,+8.1%), Norfolk (-13.1%,+13.6%), Lincolnshire (-16.6%,+13.8%), and Berkshire (-8.9%,+9.8%). Counties with a clear reduction in tertiary occupations were Hampshire (-44.2%) and Kent (-22.4%), both much impacted by the end of the Napoleon wars and reduction in defence forces (which are categorized in the service sector).

4. Industrial specialization. In section three we discussed concentration and dispersion of sectors from a county perspective. Here the focus is on industrial specialization from an industry perspective. To shed light on the question we apply the Herfindahl Index. This index measures the share of an occupation in one county in relation to the country and gives an indication of how clustered the occupation or sector is. It is defined as:

$$H = \sum_{i=1}^N s_i^2$$

where s_i is the share of the national workforce for a given occupation i in each county, and N is the number of counties. A low value (percentage) indicates a geographically dispersed industry with clusters in most counties. A percentage above 25% indicates a high concentration and significant clusters in only a few counties. Table 3 below shows the Herfindahl Index for occupations in 1801 and 1851.

Table 3. Herfindahl Index measures for occupations in 1801 and 1851.

Occupation	1801	1851	Change
1 post office	34.42%	7.48%	-26.94%
2 inland revenue	10.92%	6.28%	-4.64%
3 customs	19.32%	9.37%	-9.95%
4 other government officers	42.04%	21.94%	-20.10%
5 police	100.00%	18.03%	-81.97%
6 union relieving officer	3.47%	3.25%	-0.22%
7 office of local board	8.53%	6.38%	-2.15%
8 county, local, -officer (not otherwise distinguished)	3.35%	5.84%	2.49%
9 east india service	98.65%	18.87%	-79.78%
10 army officer	14.18%	12.21%	-1.97%
11 army half-pay officer	4.27%	23.09%	18.82%
12 soldier	14.17%	13.11%	-1.07%
13 Chelsea pensioner	100.00%	5.71%	-94.29%
14 navy officer	43.87%	13.20%	-30.67%
15 navy half-pay officer	4.12%	11.11%	6.99%
16 seaman, r.n.	47.77%	19.82%	-27.94%
17 Greenwich pensioner	100.00%	19.40%	-80.60%
18 marine	47.73%	21.85%	-25.88%

19 others engaged in defence	8.58%	10.58%	2.00%
20 clergyman	3.15%	3.10%	-0.04%
21 protestant minister (not otherwise described)	3.88%	3.79%	-0.08%
22 priest of other religious bodies	9.87%	7.63%	-2.24%
23 barrister, advocate, special pleader, conveyancer	71.63%	30.07%	-41.56%
24 solicitor, attorney, writer to signet	9.41%	10.99%	1.58%
25 other lawyers	36.63%	32.27%	-4.36%
26 physician	3.98%	11.81%	7.84%
27 surgeon, apothecary	4.64%	8.46%	3.82%
28 other medical men	25.26%	19.52%	-5.74%
29 parish clerk, clerk to church	5.80%	6.52%	0.72%
30 other union, district and parish officer	8.50%	1.50%	-6.00%
31 law clerk	21.41%	17.99%	-3.42%
32 law stationer	23.67%	30.42%	6.75%
33 druggist	4.25%	6.99%	2.74%
34 others dealing in drugs	25.40%	27.96%	2.56%
35 author	44.32%	54.04%	9.73%
36 editor, writer	26.17%	18.44%	-7.73%
37 others engaged in literature	16.30%	17.05%	0.75%
38 painter (artist)	25.16%	27.26%	2.10%
39 architect	9.09%	19.24%	10.16%
40 others engaged in the fine arts	31.96%	33.36%	1.40%
41 scientific person, observatory and museum keeper	100.00%	15.45%	-84.55%
42 music-master	21.29%	20.61%	-0.68%
43 schoolmaster, schoolmistress	3.93%	3.94%	0.01%
44 governess	9.14%	8.65%	-0.49%
45 other teachers	12.42%	11.67%	-0.76%
46 wife (of no specified occupation)	3.58%	5.17%	1.59%
47 widow (of no specified occupation)	3.58%	4.58%	1.00%
48 son, grandson, brother, nephew (not otherwise returned)	3.58%	4.86%	1.28%
49 daughter, grand-daughter, sister, niece (not otherwise distinguished)	3.58%	5.06%	1.48%
50 scholar - under tuition at home	3.58%	6.26%	2.68%
51 scholar – under tuition at school or college	3.58%	4.62%	1.04%
52 innkeeper	3.79%	3.38%	-0.42%
53 innkeeper's wife	3.79%	3.73%	-0.06%
54 lodging-house keeper	13.74%	8.41%	-5.33%
55 officer of charitable institution	10.10%	11.02%	0.92%
56 others-boarding and lodging	0.00%	34.56%	34.56%
57 domestic servant (general)	8.62%	7.19%	-1.43%
58 housekeeper	5.80%	5.83%	0.04%
59 cook	9.52%	9.68%	0.16%
60 housemaid	9.70%	8.63%	-1.07%
61 nurse	8.86%	7.38%	-1.48%
62 inn servant	3.80%	8.24%	4.44%
63 nurse at hospital, etc.	100.00%	12.55%	-87.45%
64 midwife	3.84%	4.05%	0.22%
65 charwoman	7.82%	7.65%	-0.17%
66 coachman	13.92%	13.55%	-0.37%
67 groom	3.41%	3.24%	-0.17%
68 gardener (servant)	3.86%	3.91%	0.05%
69 hairdresser, wig-maker	3.41%	8.69%	5.29%
70 hatter	4.47%	17.31%	12.84%
71 straw hat, bonnet, -maker	7.72%	8.06%	0.33%
72 furrier	23.21%	53.15%	29.94%

73 tailor	3.54%	7.80%	4.26%
74 cap, -maker, dealer	18.58%	18.98%	0.40%
75 milliner, dressmaker	3.80%	4.20%	0.40%
76 shirtmaker, seamster	15.52%	14.73%	-0.79%
77 shawl manufacturer	20.65%	30.27%	9.62%
78 staymaker	3.34%	8.87%	5.53%
79 hosier, haberdasher	8.19%	14.91%	6.72%
80 hose (stocking) manufacture	39.35%	40.83%	1.48%
81 laundry-keeper, mangler	32.15%	9.80%	-22.36%
82 rag, -gatherer, dealer	21.34%	14.01%	-7.33%
83 glover (material not stated)	13.19%	15.46%	2.27%
84 shoemaker, bootmaker	3.36%	5.30%	1.94%
85 shoemaker's wife	3.36%	4.99%	1.63%
86 patten, clog, -maker	5.89%	22.48%	16.59%
87 umbrella, parasol, stick, -maker	12.49%	25.54%	13.05%
88 others providing dress	20.68%	18.42%	-2.26%
89 house proprietor	6.14%	6.17%	0.03%
90 merchant	13.27%	19.41%	6.15%
91 banker	5.05%	4.86%	-0.19%
92 ship-agent	47.82%	15.42%	-32.40%
93 broker	30.90%	15.58%	-15.32%
94 agent, factor	20.93%	13.12%	-7.81%
95 salesman, saleswoman	7.84%	43.71%	35.87%
96 auctioneer, appraiser, valuer	4.46%	8.99%	4.53%
97 accountant	34.83%	10.70%	-24.13%
98 commercial clerk	11.99%	24.60%	12.61%
99 commercial traveller	16.17%	16.59%	0.42%
100 pawnbroker	6.07%	22.94%	16.87%
101 shopkeeper (branch undefined)	23.42%	7.48%	-15.95%
102 shopkeeper's wife	23.25%	7.12%	-16.13%
103 hawker, pedlar	12.26%	9.16%	-3.10%
104 other general merchants, dealers, agents	20.86%	21.30%	0.44%
105 railway engine, -driver, stoker		8.59%	
106 others engaged in railway traffic		6.94%	
107 toll collector	11.69%	3.41%	-8.29%
108 coach and cab owner	7.39%	24.36%	16.97%
109 livery-stable keeper	10.11%	20.49%	10.38%
110 coachman (not domestic servant)	14.35%	14.14%	-0.21%
111 carman, carrier, carter, drayman	6.99%	10.30%	3.31%
112 omnibus, -owner, conductor		42.53%	
113 others engaged in road conveyance	58.86%	58.79%	-0.07%
114 canal and inland navigation service	23.19%	7.20%	-15.99%
115 boat and bargeman	28.87%	5.33%	-23.55%
116 others connected with inland navigation	48.67%	15.36%	-33.31%
117 ship-owner	32.20%	9.36%	-22.84%
118 seaman (merchant service)	8.18%	8.42%	0.24%
119 pilot	20.24%	9.70%	-10.54%
120 others connected with sea navigation	27.03%	27.12%	0.09%
121 warehouseman	56.19%	26.96%	-29.23%
122 others connected with storage	16.78%	28.56%	11.78%
123 messenger, porter (not government), errand-boy	27.96%	17.25%	-10.72%
124 others employed about messages	12.02%	11.77%	-0.25%
125 land proprietor	3.70%	3.72%	0.02%
126 farmer	3.90%	3.89%	-0.01%

127 grazier	9.63%	9.64%	0.01%
128 farmer's, grazier's wife	4.37%	4.11%	-0.26%
129 farmer's, grazier's son, grandson, brother, nephew	4.34%	4.22%	-0.12%
130 farmer's, grazier's daughter, grand-daughter, sister	3.70%	3.82%	0.13%
131 farm bailiff	3.67%	3.62%	-0.05%
132 agricultural labourer (outdoor)	3.18%	2.88%	-0.30%
133 shepherd	4.28%	4.28%	0.00%
134 farm servant (indoor)	4.27%	4.37%	0.11%
135 others connected with agriculture	3.83%	24.27%	20.44%
136 woodman	3.57%	3.71%	0.15%
137 others connected with arboriculture	6.46%	6.09%	-0.37%
138 gardener	3.97%	3.90%	-0.06%
139 nurseryman	8.33%	6.21%	-2.12%
140 others connected with horticulture	17.52%	24.48%	6.95%
141 horse-dealer	7.08%	5.81%	-1.28%
142 groom, horse-keeper, jockey	5.50%	6.28%	0.78%
143 farrier, veterinary surgeon	6.10%	10.43%	4.33%
144 cattle, sheep, dealer, salesman	26.60%	4.22%	-22.38%
145 drover	7.67%	7.65%	-0.02%
146 gamekeeper	2.98%	3.00%	0.02%
147 vermin-destroyer	4.51%	4.34%	-0.18%
148 fisherman	22.55%	7.02%	-15.53%
149 others engaged about animals	3.64%	3.76%	0.12%
150 bookseller, publisher	4.19%	17.35%	13.16%
151 bookbinder	5.32%	28.21%	22.89%
152 printer	3.95%	23.73%	19.78%
153 others engaged about publications	47.38%	48.17%	0.80%
154 actor	19.36%	23.10%	3.74%
155 others engaged about theatres	24.64%	42.52%	17.89%
156 musician (not teacher)	4.69%	14.46%	9.77%
157 musical instrument, -maker, dealer	11.25%	70.96%	59.72%
158 others connected with music	34.65%	38.15%	3.50%
159 engraver	13.89%	24.71%	10.82%
160 others employed about pictures and engravings	45.64%	43.83%	-1.81%
161 others engaged about figures and carving	41.03%	38.67%	-2.36%
162 artificial flower maker	74.54%	87.37%	12.82%
163 toy, -maker, dealer	12.94%	21.43%	8.49%
164 persons connected with shows, games and sports	22.14%	22.62%	0.48%
165 civil engineer	11.85%	12.86%	1.01%
166 pattern designer	18.47%	20.77%	2.30%
167 other designers and draughtsmen	24.24%	25.47%	1.23%
168 medallist and medal-maker	24.06%	27.65%	3.58%
169 watchmaker, clockmaker	3.59%	13.65%	10.06%
170 philosophical instrument maker	56.62%	27.42%	-29.20%
171 gunsmith	5.46%	26.50%	21.04%
172 others engaged in manufacture of arms	41.67%	46.49%	4.82%
173 engine and machine maker	7.73%	14.83%	7.11%
174 tool-maker	8.41%	18.64%	10.23%
175 others dealing in tools and machines	28.58%	30.79%	2.21%
176 coach maker	7.83%	12.64%	4.81%
177 others connected with carriage making	12.62%	14.97%	2.35%
178 saddler, harness-maker	3.26%	4.78%	1.52%
179 whip-maker	8.92%	17.06%	8.14%
180 other harness-makers	10.37%	22.44%	12.07%

181 shipwright, shipbuilder	16.00%	9.77%	-6.23%
182 boat, barge, -builder	12.97%	7.63%	-5.34%
183 others engaged in fittings ships	18.41%	18.33%	-0.08%
184 surveyor	4.54%	10.32%	5.78%
185 builder	10.66%	7.76%	-2.90%
186 carpenter, joiner	3.46%	4.98%	1.52%
187 bricklayer	6.47%	7.19%	0.73%
188 mason, pavior	4.76%	6.14%	1.39%
189 slater	8.77%	14.24%	5.47%
190 plasterer	10.62%	11.88%	1.26%
191 painter, plumber, glazier	4.36%	10.62%	6.27%
192 others engaged in house construction	26.72%	51.23%	24.51%
193 wheelwright	4.62%	3.67%	-0.95%
194 millwright	6.52%	8.06%	1.53%
195 other implement makers	5.37%	5.95%	0.58%
196 dyer, scourer, calenderer	4.34%	19.86%	15.52%
197 others engaged in manufacture of chemicals	13.47%	13.97%	0.50%
198 cowkeeper, milkseller	14.00%	15.07%	1.07%
199 cheesemonger	8.27%	57.37%	49.10%
200 butcher, meat salesman	3.94%	5.24%	1.30%
201 butcher's wife	3.93%	4.52%	0.59%
202 provision curer	100.00%	59.84%	-40.16%
203 poulterer, gamedealer	10.47%	12.65%	2.18%
204 fishmonger, dealer, seller	6.12%	13.15%	7.03%
205 others dealing in animal food	12.06%	12.58%	0.52%
206 soap-boiler	7.71%	16.39%	8.68%
207 tallow-chandler	4.15%	12.21%	8.07%
208 comb-maker (for manufactures)	13.41%	20.19%	6.78%
209 others dealing in grease and bones	23.11%	24.01%	0.90%
210 fellmonger	7.68%	4.26%	-3.42%
211 skinner	6.96%	5.89%	-1.07%
212 currier	3.70%	9.22%	5.51%
213 tanner	3.62%	6.51%	2.89%
214 other workers in leather	29.84%	31.31%	1.46%
215 feather, -dresser, dealer	100.00%	39.49%	-60.51%
216 hair, bristle, -manufacture	23.48%	16.77%	-6.71%
217 brush, broom, -maker	9.07%	16.80%	7.73%
218 other workers dealers in hair	16.51%	17.01%	0.49%
219 woolstapler	17.83%	10.36%	-7.47%
220 knitter	7.71%	7.94%	0.23%
221 woollen cloth manufacture	11.95%	42.97%	31.02%
222 fuller	35.37%	48.38%	13.01%
223 worsted manufacture	11.77%	89.55%	77.78%
224 stuff manufacture	16.44%	56.20%	39.75%
225 clothier	20.44%	56.70%	36.26%
226 woollen draper	8.31%	11.89%	3.58%
227 carpet, rug, -manufacture	20.19%	29.81%	9.63%
228 other workers, dealers in wool	17.46%	18.32%	0.86%
229 silk manufacture	19.65%	15.29%	-4.36%
230 silkmercer	68.67%	21.64%	-47.03%
231 ribbon manufacture	80.42%	82.19%	1.78%
232 fancy goods manufacture	50.03%	54.84%	4.81%
233 embroiderer	33.75%	32.40%	-1.34%
234 other workers, dealers in silk	0.00%	20.79%	20.79%

235 greengrocer	98.35%	16.67%	-81.68%
236 corn merchant	6.79%	9.78%	2.99%
237 miller	6.57%	3.10%	-3.48%
238 flour-dealer	11.30%	9.03%	-2.27%
239 baker	3.69%	7.70%	4.01%
240 confectioner	4.41%	8.66%	4.24%
241 others dealing in vegetable food	14.83%	16.80%	1.96%
242 maltster	4.26%	3.65%	-0.61%
243 brewer	5.17%	5.51%	0.34%
244 licensed victualler, beershopkeeper	8.63%	6.69%	-1.93%
245 licensed victualler, beershopkeeper's wife	8.03%	5.93%	-2.09%
246 wine and spirit merchant	6.19%	12.05%	5.86%
247 sugar-refiner	27.66%	38.86%	11.20%
248 grocer	3.08%	4.65%	1.57%
249 tobacconist	19.76%	28.94%	9.18%
250 others dealing in drinks, stimulants	27.39%	30.03%	2.64%
251 oil and colourman	68.67%	74.14%	5.47%
252 french-polisher	40.96%	40.78%	-0.18%
253 other workers, dealers in oils, gums &c	13.57%	13.82%	0.25%
254 timber merchant	5.33%	8.58%	3.25%
255 other dealers, workers in timber	14.46%	14.66%	0.20%
256 cork-cutter	6.77%	18.20%	11.44%
257 others dealing in bark	19.57%	10.63%	-8.93%
258 sawyer	28.65%	4.10%	-24.55%
259 lath-maker	40.45%	6.30%	-34.15%
260 other wood workers	44.09%	16.78%	-27.31%
261 cabinet-maker, upholsterer	3.95%	12.90%	8.95%
262 turner	4.62%	9.50%	4.88%
263 chair-maker	7.51%	18.17%	10.67%
264 box-maker	19.52%	37.62%	18.10%
265 others dealing in wood furniture	24.63%	24.95%	0.32%
266 cooper	3.43%	9.18%	5.75%
267 other makers of wood utensils	22.30%	22.27%	-0.03%
268 frame-maker	24.72%	25.37%	0.65%
269 block and print cutter	28.53%	31.20%	2.68%
270 other wood tool makers	10.64%	10.99%	0.36%
271 basket-maker	7.21%	4.71%	-2.50%
272 thatcher	7.37%	7.83%	0.46%
273 straw plait manufacture	20.97%	26.56%	5.58%
274 other workers in cane, rush, straw	10.44%	15.38%	4.94%
275 ropemaker	5.31%	8.05%	2.74%
276 sailcloth manufacture	22.24%	9.17%	-13.07%
277 others working in hemp	9.73%	9.21%	-0.52%
278 flax, linen, -manufacture	5.97%	43.42%	37.44%
279 thread manufacture	23.31%	28.30%	4.99%
280 weaver (material not stated)	11.29%	68.25%	56.96%
281 draper	4.15%	6.85%	2.70%
282 lace manufacture	18.56%	14.82%	-3.74%
283 cotton manufacture	24.38%	60.86%	36.48%
284 lint manufacture	21.45%	66.87%	45.42%
285 packer and presser (cotton)	89.40%	92.24%	2.84%
286 fustian manufacture	80.41%	81.04%	0.63%
287 muslin embroiderer	47.38%	87.39%	40.01%
288 calico, cotton, -printer	42.24%	62.73%	20.49%

289 calico, cotton, -dyer	72.57%	74.40%	1.83%
290 other workers, dealers in flax, cotton	24.45%	22.84%	-1.62%
291 paper manufacture	11.58%	7.75%	-3.83%
292 stationer	5.00%	35.30%	30.30%
293 paper-stainer	50.29%	53.42%	3.13%
294 paper-hanger	37.15%	35.83%	-1.32%
295 other paper workers, dealers	24.71%	16.41%	-8.30%
296 coal-miner	10.31%	10.30%	-0.01%
297 coal, -merchant, dealer	8.31%	6.58%	-1.73%
298 coal heaver or labourer	13.91%	12.48%	-1.43%
299 chimney-sweeper	42.71%	6.15%	-36.56%
300 gasworks service	0.00%	16.93%	16.93%
301 other dealers, workers in coal	7.35%	7.59%	0.24%
302 stone-quarrier	100.00%	12.91%	-87.09%
303 slate-quarrier	47.18%	68.82%	21.64%
304 limestone, -quarrier, burner	15.93%	5.82%	-10.11%
305 marble mason	14.81%	13.47%	-1.34%
306 brick, -maker, dealer	7.09%	4.09%	-3.01%
307 road labourer	5.26%	3.59%	-1.66%
308 railway labourer	0.00%	4.63%	4.63%
309 other workers in stone, lime, clay	5.83%	5.52%	-0.31%
310 earthenware manufacture	11.18%	53.81%	42.63%
311 earthenware and glass dealer	4.41%	8.43%	4.02%
312 tobacco-pipe maker	11.21%	10.00%	-1.21%
313 glass manufacture	17.64%	12.18%	-5.46%
314 other workers in glass	36.98%	28.38%	-8.60%
315 salt, -agent, merchant, dealer	16.27%	41.23%	24.95%
316 water, -carrier, dealer	12.27%	11.43%	-0.84%
317 workers, dealers in precious stones	29.11%	33.27%	4.16%
318 goldsmith, silversmith	9.16%	27.32%	18.16%
319 plater	35.97%	36.77%	0.81%
320 carver, gilder	9.89%	24.93%	15.04%
321 other workers in gold and silver	32.40%	31.71%	-0.68%
322 copper-miner	55.56%	75.36%	19.80%
323 copper manufacture	55.56%	70.24%	14.69%
324 coppersmith	18.05%	16.66%	-1.39%
325 other workers, dealers in copper	19.41%	21.11%	1.70%
326 tin-miner	100.00%	90.31%	-9.69%
327 tinman, tin-worker, tinker	5.36%	9.22%	3.86%
328 other workers, dealers in tin	10.60%	12.02%	1.41%
329 zinc manufacture	46.34%	51.78%	5.44%
330 other workers and dealers in zinc	29.60%	52.33%	22.73%
331 lead-miner	11.93%	11.56%	-0.37%
332 lead manufacture	32.54%	15.73%	-16.81%
333 other workers, dealers in lead	17.16%	14.34%	-2.82%
334 brass, -manufacture, founder, moulder	18.26%	26.29%	8.03%
335 locksmith, bellhanger	24.47%	58.91%	34.44%
336 brazier	4.00%	11.16%	7.15%
337 white metal manufacture	38.30%	39.73%	1.43%
338 pin manufacture	49.18%	21.37%	-27.81%
339 button-maker (all branches)	34.05%	61.66%	27.61%
340 wire, -maker, drawer	43.92%	36.77%	-7.16%
341 wire, -worker, weaver	16.29%	18.00%	1.71%
342 other workers, dealers in mixed metals	21.05%	22.13%	1.08%

343 iron-miner	19.71%	19.27%	-0.44%
344 iron, manufacturer, moulder, founder	15.20%	9.71%	-5.49%
345 whitesmith	5.02%	6.50%	1.48%
346 blacksmith	3.79%	3.92%	0.13%
347 nail manufacture	8.87%	25.23%	16.36%
348 anchorsmith, chainsmith	38.72%	20.33%	-18.38%
349 boiler-maker	13.04%	13.38%	0.35%
350 ironmonger	4.03%	6.88%	2.85%
351 file-maker	30.75%	51.69%	20.94%
352 cutler	6.78%	58.48%	51.70%
353 needle manufacture	23.11%	35.95%	12.83%
354 grinder (branch undefined)	21.11%	25.52%	4.40%
355 other workers, dealers in iron, steel	24.25%	22.24%	-2.02%
356 labourer (branch undefined)	6.03%	5.53%	-0.50%
357 mechanic, manufacturer, shopman, shopwoman	26.45%	18.69%	-7.76%
358 others of indefinite occupations	15.60%	13.76%	-1.85%
359 gentleman, gentlewoman, independent	9.41%	9.29%	-0.12%
360 annuitant	6.72%	7.18%	0.46%
361 others of independent means	37.11%	94.94%	57.84%
362 dependent on relatives (not classed elsewhere)	8.03%	7.47%	-0.56%
363 almsperson	4.96%	4.97%	0.01%
364 pauper of no stated occupation	3.48%	3.42%	-0.06%
365 lunatic of no stated occupation	5.55%	5.78%	0.23%
366 others supported by the community	8.41%	10.70%	2.30%
369 persons of no stated occupations or conditions	17.09%	7.32%	-9.77%
367 prisoner of no stated occupation	16.77%	36.51%	19.74%
368 vagrant in barns, tents, etc.	3.50%	3.33%	-0.17%

Source: own calculations.

The average Herfindahl measure for 1801 was 19.4%, and for 1851 it was 20.1%. The English and Welsh occupational structure was lightly concentrated in 1801 and this hardly changed up to 1851. Overall we observe increased concentration in certain professions but dispersion in others, as discussed above.

Note the declining concentration of Government services, including the Post Offices, police and other Government officers (as well as the East India Service). In 1801, only the Metropolitan Police force in London was active; this had changed by 1851 and the Herfindahl index fell from 100% to 18%. Police forces were needed on a wider basis and all counties had a police corps. In 1801, 1 000 of the 1 717 persons employed by the Post Office were in London; by 1851 only 23.7% of workers were found there as positions had been spread to the counties. England and Wales was a country in structural change at the time. With improved means of transport and communication, regions grew and higher levels of Government services were needed outside London. The same is true of business services. See how the concentration of accountants, ship agents and brokers all declined markedly. The growth of business activity was clearly faster in the regions than in London.

Persons engaged in entertaining, clothing and personal offices for men and women were more dispersed. In 1801 the Herfindahl for these occupations was 12.8% and it hardly changed up to 1851. A few occupations are noteworthy. Hatters, umbrella makers, patten makers and furriers all concentrated considerably. In 1801, we found 28 furriers (35% of total) in London, 21 in Lincolnshire and the rest spread out over six other counties. By 1851,

72.5% of the 1 906 furriers were active in London. Clog making is another good example of occupational concentration. The Herfindahl index for 1801 shows a level of 5.9%, a spread out activity. However by 1851, Lancashire went from 25 to 1 623 clog-makers (from 1.1% to 44.1% of the clog making in England and Wales). Now, Lancashire was the big centre but - unlike furriers, were London had “taken them all” - important manufacturing also took place in other counties such as West Yorkshire, London and Cumberland.

A very important point to note here is that measurement error is likely biasing the results *against* finding more dispersion from 1801 to 1851. We assume the 1851 census is accurate. We might suppose that the UBD missed businesses, especially those in small-towns and villages. Se we might expect to see a fall in concentration in the data (small firms not reported in 1801, but reported in 1851, would make it appear that concentration has fallen). But we find the opposite – fewer small businesses spread around the country in 1851 than 1801. This suggests the UBD volumes are very complete and trustworthy.

Transport, particularly canal and inland navigation, became more evenly distributed over the country in the fifty years to 1851. The clustering of boat and bargemen, ship owners, canal and inland navigation and warehousemen all decreased by more than 20%. In the first part of the 19th century grand canals such as the Caledonian Canal opened. But from mid-century canal transport started declining as the new railways started to play a role. In 1806 the first commercial railway opened in Wales, transporting coal, iron-ore and limestone, in addition to its first passengers in 1807.³ In 1830 the first intercity railway opened between Manchester and Liverpool and set new standards for transport. By mid-century railway transport was significant in comparison to older modes of transport. In 1801, no one was engaged in railway traffic; by 1851, 25 236 people were engaged on the railways. These were spread widely over the counties. Agricultural activities were, not surprisingly, widely dispersed in 1801. The Herfindahl Index for the whole census class is 5.5%. In line with our discussions above, the index increased slightly to 7.0% by 1851 as some counties came to specialize more in food production (assisted by cheap and timely transport).

Occupations connected to art and mechanic productions saw strong growth, as mentioned previously. But also the average Herfindahl level for these occupations increased from 16.7%, by 6.1%. Musical instrument makers is a good example. In 1801, musical instrument makers were few (71 persons) and spread relatively equally all over the country. In 1851, on the other hand, 2 929 of the now 3 456 musical instrument makers were active in London. Tool-making experienced a similar tendency. Most of the 944 in 1801 were found in a line crossing mid-England from the south to the north; no county had more than 150 tool makers. By 1851, however, certain counties stuck out. Of the 4 060 tool makers, 947 were in West Yorkshire, 856 in Warwickshire and 566 in Lancashire. The Herfindahl index for tool-makers went from 8.4% to 18.6%. Gunsmiths and watchmakers saw a similar change.

Greengrocers belong to the class of people engaged in matters from the vegetable kingdom. A greengrocer was hard to find outside the bigger metropolitan areas of London/Middlesex and Lancashire in 1801. The Herfindahl index confirms this with a level of 98.4%. Not surprisingly, by 1851 greengrocers could be found everywhere and the concentration level went down to 16.67%. This was less the case for millers, corn merchants, bakers, confectioners, brewers and general grocers. These services were already demanded locally all over England and Wales and had very low concentrations in 1801, and only insignificant changes during the next fifty years. More specialized trades such as sugar-

³ https://en.wikipedia.org/wiki/Swansea_and_Mumbles_Railway

refiners, oil and colourmen were to a larger degree already concentrated in city centres in 1801. Professions dealing in wood (including turners, cabinet-makers, chair-makers and box-makers) went through a roughly ten percentage point increase in concentration levels from 1801 to 1851.

We noted above the big reorganization in cloth production and we see it here again in the Herfindahl indices. The concentration of *woollen cloth manufacture* went up from 12.0% to 43.0%. Stuff manufacture increased to 56.2% and worsted manufacture even up to 89.6%. Worsteds fabrication literally disappeared in many counties and a big part of the manufacture was concentrated in West Yorkshire. Woollen cloth manufacture went through a similar process. Manufacture halted in most counties, clustering went up and only West Yorkshire, Wiltshire, Lancashire and Gloucestershire had industry of national importance.

In the fifty years from 1801 to 1851, cotton manufacture concentrated strongly in and around Lancashire. In 1801 the percentage was 24.4%, which already points to a high level of clustering. Over the next five decades the level rose to an impressive 60.9%. For cotton packers and pressers, the Herfindahl index was even more impressive. Already by 1801, 638 out of the 675 packers and pressers found in England and Wales were active in Lancashire; towards 1851 the concentration in Lancashire grew even higher, with 96% of such workers being active there. Other occupations in cotton were not that dense, but calico and cotton printers, flax and linen manufacture, muslin embroiderer, lint manufacture and thread manufacture was still fairly concentrated, all with Herfindahl levels above 20%. In 1801, lint manufacture was centred in London and Norfolk. Thread-manufacture was in London, Devonshire and Gloucestershire. Both in Devonshire and Gloucestershire, thread-manufacture disappeared completely by 1851. Actually the whole production halted and the profession nationally went from 23 385 incumbents in 1801 to 842 in 1851. Flax and linen manufacture had the same destiny. It contracted from 192 969 workers in 1801 to 26 235 in 1851. In the beginning of the period, linen and flax manufacturer could be found in important quantities in most English and Wales counties. We found the most important clusters in Norfolk (26 501) and West Yorkshire (22 983). Twelve other counties each had more than 5 000 workers. In 1851, West Yorkshire was the only county with a size comparable to the levels of 1801 (9 629 workers). Lancashire was number two (2 132), all other counties having only insignificant populations.

In 1801 there were 14 485 lace makers; 4 135 in London, 3 437 in Buckinghamshire, 2 504 in Northamptonshire and 1 672 in Nottinghamshire. Lancashire had only 71 lace makers in 1801. By 1851 both Bedfordshire and Derbyshire gained momentum and became noteworthy lace counties, so the Herfindahl index actually went down from 18.6% to 14.8%. Weavers is another occupation of particular interest, given its importance in industrialization. In 1801, 177 667 weavers were active in England and Wales scattered across every county. Relatively large clusters were found in London (50 350), Kent (19 029) and North and West Yorkshire (12 073 and 10 141). As with thread-manufacture, this business vanished and was replaced by modern technology. By 1851 only 3 749 weavers were left, of which 3 083 were in Lancashire in connection with the cotton manufacture.

Class XIV lists persons engaged in minerals. Two points are obvious. Activities depending on geography, such as mining, have high concentration levels that hardly change over time. However some of the manufacturing coming from minerals, and the subsequent trade, do show patterns of concentration. A good example is earthenware manufacture. In 1801, this activity could be found in more than twenty counties. In total 27 966 persons engaged in this craft. Derbyshire (5 796) and Devonshire (4 463) were the two counties with

the biggest settlements, and Staffordshire was number three with 3 321 earthenware manufacturers. But Staffordshire was ideally situated, and had access to coal and clay in important quantities.⁴ Entrepreneurs such as Josiah Wedgwood had already established factories in Staffordshire and these picked up an important share between 1801 and 1851. The Herfindahl went from 11.2% in 1801 to 53.8% in 1851. Both Derbyshire and Devonshire lost most of their capacity and had only bits of production left.

It's a similar story for button-makers. At the beginning of the 19th century, Warwickshire and Birmingham had an important button industry, but operations could also be found in London, Cheshire and four or five other counties. By 1851, 6 938 persons (three times more) were active and half of these were in Warwickshire. The Herfindahl index went from 34.1% to 61.7%. Locksmiths and bell hangers, centred in Staffordshire, went through a similar clustering, the Herfindahl rising from 24.5% to 58.9%. Both of these trades were connected to, and clustered around, Birmingham. Another activity concentrated around Birmingham was nail manufacture. In 1801, the Herfindahl index was 8.9% with 4 811 nail makers mainly in West Yorkshire (757), North Wales (650), Northumberland (572) and Lancashire (449). Over the next fifty years, Birmingham and the surrounding counties took a clear lead. In 1851, there were 26 940 active nail makers, with Staffordshire and Worcestershire settling as the most important production centres with a combined workforce of 13 014 (48.3% of total workers).

5. Conclusion. Marshall's (1890) discussion of the concentration of specialized industries into particular localities fits well with the occupational shifts and the regional movements between 1801 and 1851.⁵ Marshall noted several causes of the formation of industrial districts. Primary causes are physical and geographical conditions - such as accessibility by land or water, or closeness to minerals and cheap energy (coal). In addition, for a skilled workforce in one particular sector "mysteries of the trade become no mysteries", as workers in similar and local industries share their experiences, inventions and improvements both "in machinery, in processes and the general organization of the business". Marshall further holds that improved transport is crucial, as it allows for splitting up processes and locating different industries in several different places. It allows for example certain counties to specialise in food production and others in manufacturing whilst allowing both to get their essential inputs (food for factory workers, ploughs for farmers). In general, the observed tendencies between 1801 and 1851 follow Marshall's assertions. Marshall compared the 1851 and 1881 census, and noted that the population moved away from agricultural occupations into mechanical and manufacturing work, but also tertiary engagements such as education, domestic services and building. Very much the same dynamics can be seen from 1801 to 1851. But the period 1801 to 1851 was marked not only by a rapid increase in the national level of industrialization, but also by the clustering of several important sectors into Marshallian industrial districts. Woollen cloth production centred in and around West Yorkshire, cotton manufacture in Lancashire, flax and linen manufacture in Lancashire and West Yorkshire, lint manufacture in Lancashire, iron manufacture in Monmouthshire, Cumberland and Worcestershire, lace making in Bedfordshire and Derbyshire, earthenware in Staffordshire, button making and nail making in and around Birmingham.

⁴ <http://britishheritage.com/potteries-of-staffordshire/>

⁵ Marshall, Alfred, "Principles of Economics", Chapter X, pp. 328-338, MacMilland and Co., London and New York (1890)

As one would expect, transportation, on the other hand, became more dispersed. Ship-agents, boat and bargemen, ship owners and warehousemen settled along the new transport network. Service professions, such as accountants, barristers and lawyers followed new business and settled to a higher degree outside London; so did Government service workers such as police officers and post offices. Engineering and construction professionals neither concentrated nor dispersed; but the number of workers exploded. Industry needed machines and the workers needed houses. Counties outside the new industrial centres specialized in farming; the counties surrounding London are a good example.

Some of these findings are not new. The concentration of the woollen industry is well documented, for example. But we have found new and reliable sources to quantify this evolution in a detailed and comprehensive manner. Using the UBD, and several other sources, we have been able to construct an 1801 regional occupational census with satisfying confidence levels. Our numbers confirm developments highlighted in economic history papers, and this supports the rigor of our tables. However, there are still numerous open questions to be answered by future research. An internet site is accessible under www.1801census.com with all tables and details for those who would like to use our work for further analysis.

Appendix 1. Occupations for England and Wales and per county according to a PST structure.

England and Wales	1801	1851	1801	1851
The Primary Sector	18.05 %	12.84 %	37.34 %	27.62 %
1.1 The products of land and water	16.95 %	11.20 %	35.07 %	24.09 %
1.2 Mining and quarrying	1.10 %	1.64 %	2.28 %	3.53 %
The Secondary Sector	16.93 %	18.81 %	35.02 %	40.48 %
2.1 Food, drink, and tobacco	0.58 %	1.20 %	1.19 %	2.58 %
2.2 Clothing and footwear	2.02 %	5.11 %	4.17 %	11.00 %
2.3 Textiles	8.67 %	5.10 %	17.94 %	10.98 %
2.4 Wood industries	0.26 %	0.71 %	0.54 %	1.54 %
2.5 Furnishing	0.64 %	0.58 %	1.33 %	1.25 %
2.6 Paper industries	0.04 %	0.10 %	0.07 %	0.21 %
2.7 Printing and publishing	0.04 %	0.17 %	0.08 %	0.38 %
2.8 Earthenware, pottery manufacture	0.31 %	0.19 %	0.63 %	0.41 %
2.9 Other dealers (not in the PST table)	2.92 %	2.58 %	6.05 %	5.56 %
2.10 Building and construction	1.43 %	2.99 %	2.97 %	6.43 %
2.11 Glass manufacture	0.02 %	0.07 %	0.04 %	0.15 %
The Tertiary Sector	13.36 %	14.83 %	27.63 %	31.90 %
3.1 Dealers in the raw products	1.91 %	2.08 %	3.96 %	4.48 %
3.2 Transport	2.71 %	2.40 %	5.60 %	5.15 %
3.3 Hotels, restaurants, public houses	1.01 %	1.30 %	2.09 %	2.79 %
3.4 Domestic service	2.93 %	4.48 %	6.07 %	9.65 %
3.5 Financial, commercial, administrative services	1.65 %	2.84 %	3.41 %	6.11 %
3.6 Owners, possessors of capital	1.03 %	0.90 %	2.12 %	1.94 %
3.7 Public, government, church service	0.31 %	0.35 %	0.65 %	0.76 %
3.8 Titled, gentleman	0.14 %	0.14 %	0.28 %	0.31 %
3.9 Armed forces	1.66 %	0.33 %	3.44 %	0.72 %
Nonprofessional categories (wives, children students, etc.)	51.67 %	53.52 %		
4.1 Widows, scholars, sons, daughters, others	51.67 %	53.52 %		
Total	100.00 %	100.00 %	100.00 %	100.00 %

Bedfordshire	1801	1851	1801	1851	Change
The Primary Sector	26.67%	18.91%	55.73%	34.72%	-21.02%
The Secondary Sector	14.28%	26.73%	29.84%	49.07%	19.24%
The Tertiary Sector	6.90%	8.83%	14.43%	16.21%	1.78%
Nonprofessional categories	52%	46%			

Berkshire	1801	1851	1801	1851	Change
The Primary Sector	24.93%	19.61%	51.69%	42.80%	-8.89%
The Secondary Sector	12.28%	11.23%	25.46%	24.52%	-0.94%
The Tertiary Sector	11.02%	14.98%	22.85%	32.68%	9.83%
Nonprofessional categories	51.77%	54.18%			
Buckinghamshire	1801	1851	1801	1851	Change
The Primary Sector	18.76%	19.54%	39.82%	38.00%	-1.82%
The Secondary Sector	17.93%	20.91%	38.06%	40.67%	2.60%
The Tertiary Sector	10.42%	10.97%	22.11%	21.33%	-0.78%
Nonprofessional categories	52.89%	48.59%			
Cambridgeshire	1801	1851	1801	1851	Change
The Primary Sector	30.89%	19.27%	64.99%	46.79%	-18.20%
The Secondary Sector	6.82%	9.49%	14.36%	23.05%	8.69%
The Tertiary Sector	9.81%	12.42%	20.65%	30.16%	9.51%
Nonprofessional categories	52.48%	58.83%			
Cheshire	1801	1851	1801	1851	Change
The Primary Sector	19.34%	11.49%	40.90%	23.71%	-17.19%
The Secondary Sector	19.33%	23.45%	40.89%	48.37%	7.48%
The Tertiary Sector	8.61%	13.53%	18.21%	27.92%	9.71%
Nonprofessional categories	52.72%	51.53%			
Cornwall	1801	1851	1801	1851	Change
The Primary Sector	26.22%	24.47%	53.99%	54.18%	0.20%
The Secondary Sector	12.69%	10.70%	26.12%	23.69%	-2.42%
The Tertiary Sector	9.66%	9.99%	19.90%	22.13%	2.23%
Nonprofessional categories	51.43%	54.84%			
Cumberland	1801	1851	1801	1851	Change
The Primary Sector	27.18%	19.75%	55.50%	41.24%	-14.26%
The Secondary Sector	12.64%	15.86%	25.81%	33.10%	7.29%
The Tertiary Sector	9.16%	12.29%	18.69%	25.66%	6.97%
Nonprofessional categories	51.02%	52.10%			
Derbyshire	1801	1851	1801	1851	Change
The Primary Sector	16.34%	14.94%	33.72%	30.38%	-3.34%
The Secondary Sector	25.40%	24.31%	52.42%	49.44%	-2.99%
The Tertiary Sector	6.71%	9.92%	13.85%	20.18%	6.33%
Nonprofessional categories	51.55%	50.83%			
Devonshire	1801	1851	1801	1851	Change
The Primary Sector	20.62%	17.32%	41.72%	36.07%	-5.65%
The Secondary Sector	17.78%	15.43%	35.97%	32.12%	-3.85%
The Tertiary Sector	11.03%	15.28%	22.31%	31.82%	9.51%
Nonprofessional categories	50.58%	51.97%			
Dorsetshire	1801	1851	1801	1851	Change

The Primary Sector	19.78%	18.70%	40.62%	40.61%	-0.01%
The Secondary Sector	15.93%	14.73%	32.72%	31.98%	-0.74%
The Tertiary Sector	12.98%	12.62%	26.66%	27.40%	0.74%
Nonprofessional categories	51.31%	53.96%			
Durham	1801	1851	1801	1851	Change
The Primary Sector	18.64%	14.12%	38.87%	34.90%	-3.97%
The Secondary Sector	14.51%	14.22%	30.26%	35.13%	4.87%
The Tertiary Sector	14.81%	12.13%	30.87%	29.97%	-0.90%
Nonprofessional categories	52.04%	59.53%			
Essex	1801	1851	1801	1851	Change
The Primary Sector	19.57%	19.16%	38.44%	44.67%	6.23%
The Secondary Sector	11.69%	11.43%	22.97%	26.66%	3.68%
The Tertiary Sector	19.64%	12.30%	38.59%	28.67%	-9.92%
Nonprofessional categories	49.09%	57.11%			
Gloucestershire	1801	1851	1801	1851	Change
The Primary Sector	14.17%	11.81%	29.87%	25.44%	-4.43%
The Secondary Sector	19.37%	16.54%	40.82%	35.65%	-5.18%
The Tertiary Sector	13.90%	18.06%	29.31%	38.91%	9.60%
Nonprofessional categories	52.56%	53.60%			
Hampshire	1801	1851	1801	1851	Change
The Primary Sector	13.11%	12.88%	22.68%	29.88%	7.20%
The Secondary Sector	12.26%	11.57%	21.20%	26.86%	5.66%
The Tertiary Sector	32.44%	18.64%	56.11%	43.26%	-12.85%
Nonprofessional categories	42.18%	56.91%			
Herefordshire	1801	1851	1801	1851	Change
The Primary Sector	16.22%	23.49%	33.16%	49.02%	15.86%
The Secondary Sector	22.17%	11.45%	45.32%	23.90%	-21.42%
The Tertiary Sector	10.53%	12.97%	21.52%	27.08%	5.56%
Nonprofessional categories	51.09%	52.09%			
Hertfordshire	1801	1851	1801	1851	Change
The Primary Sector	17.21%	18.44%	35.96%	39.15%	3.19%
The Secondary Sector	20.22%	16.56%	42.24%	35.16%	-7.08%
The Tertiary Sector	10.44%	12.10%	21.81%	25.69%	3.89%
Nonprofessional categories	52.13%	52.90%			
Huntingdonshire	1801	1851	1801	1851	Change
The Primary Sector	24.57%	21.61%	50.32%	49.48%	-0.84%
The Secondary Sector	16.40%	11.62%	33.59%	26.60%	-6.98%
The Tertiary Sector	7.86%	10.44%	16.09%	23.91%	7.82%
Nonprofessional categories	51.17%	56.33%			
Kent	1801	1851	1801	1851	Change

The Primary Sector	14.92%	14.22%	28.36%	33.60%	5.24%
The Secondary Sector	12.57%	10.39%	23.87%	24.55%	0.68%
The Tertiary Sector	25.14%	17.71%	47.77%	41.85%	-5.92%
Nonprofessional categories	47.37%	57.67%			
Lancashire	1801	1851	1801	1851	Change
The Primary Sector	12.14%	5.99%	25.97%	12.08%	-13.89%
The Secondary Sector	22.00%	29.56%	47.06%	59.59%	12.53%
The Tertiary Sector	12.61%	14.05%	26.97%	28.33%	1.36%
Nonprofessional categories	53.25%	50.40%			
Leicestershire	1801	1851	1801	1851	Change
The Primary Sector	17.98%	13.12%	36.88%	25.42%	-11.46%
The Secondary Sector	23.92%	26.97%	49.07%	52.24%	3.16%
The Tertiary Sector	6.85%	11.54%	14.05%	22.35%	8.30%
Nonprofessional categories	51.25%	48.37%			
Lincolnshire	1801	1851	1801	1851	Change
The Primary Sector	30.43%	20.52%	63.00%	46.38%	-16.62%
The Secondary Sector	9.66%	10.11%	20.01%	22.84%	2.83%
The Tertiary Sector	8.21%	13.62%	17.00%	30.78%	13.79%
Nonprofessional categories	51.70%	55.75%			
London	1801	1851	1801	1851	Change
The Primary Sector	1.59%	1.10%	3.61%	2.40%	-1.20%
The Secondary Sector	15.97%	18.13%	36.21%	39.73%	3.52%
The Tertiary Sector	26.55%	26.40%	60.18%	57.86%	-2.32%
Nonprofessional categories	55.88%	54.38%			
Middlesex	1801	1851	1801	1851	Change
The Primary Sector	11.08%	10.50%	23.28%	25.26%	1.98%
The Secondary Sector	18.72%	10.60%	39.34%	25.50%	-13.84%
The Tertiary Sector	17.79%	20.47%	37.38%	49.24%	11.86%
Nonprofessional categories	52.40%	58.42%			
Monmouthshire	1801	1851	1801	1851	Change
The Primary Sector	30.63%	19.01%	68.89%	43.95%	-24.94%
The Secondary Sector	3.65%	13.82%	8.21%	31.94%	23.73%
The Tertiary Sector	10.18%	10.43%	22.90%	24.11%	1.21%
Nonprofessional categories	55.54%	56.74%			
Norfolk	1801	1851	1801	1851	Change
The Primary Sector	20.96%	12.25%	43.05%	29.99%	-13.06%
The Secondary Sector	17.95%	14.84%	36.86%	36.32%	-0.54%
The Tertiary Sector	9.78%	13.76%	20.10%	33.69%	13.59%
Nonprofessional categories	51.31%	59.16%			
Northamptonshire	1801	1851	1801	1851	Change

The Primary Sector	20.23%	16.59%	39.97%	33.24%	-6.73%
The Secondary Sector	21.23%	22.15%	41.94%	44.39%	2.44%
The Tertiary Sector	9.15%	11.16%	18.09%	22.37%	4.29%
Nonprofessional categories	49.39%	50.10%			
Northumberland	1801	1851	1801	1851	Change
The Primary Sector	21.52%	14.84%	44.35%	35.19%	-9.17%
The Secondary Sector	9.10%	14.26%	18.76%	33.81%	15.05%
The Tertiary Sector	17.90%	13.07%	36.88%	31.00%	-5.88%
Nonprofessional categories	51.48%	57.83%			
North Wales	1801	1851	1801	1851	Change
The Primary Sector	32.61%	26.46%	67.48%	57.49%	-9.99%
The Secondary Sector	9.94%	10.35%	20.58%	22.49%	1.91%
The Tertiary Sector	5.77%	9.21%	11.94%	20.02%	8.08%
Nonprofessional categories	51.68%	53.98%			
Nottinghamshire	1801	1851	1801	1851	Change
The Primary Sector	16.91%	13.20%	35.01%	25.60%	-9.41%
The Secondary Sector	25.07%	27.46%	51.88%	53.23%	1.35%
The Tertiary Sector	6.34%	10.92%	13.12%	21.17%	8.06%
Nonprofessional categories	51.68%	48.42%			
Oxfordshire	1801	1851	1801	1851	Change
The Primary Sector	21.34%	19.32%	43.83%	42.41%	-1.42%
The Secondary Sector	18.73%	13.27%	38.47%	29.14%	-9.33%
The Tertiary Sector	8.62%	12.96%	17.70%	28.45%	10.75%
Nonprofessional categories	51.30%	54.45%			
Rutlandshire	1801	1851	1801	1851	Change
The Primary Sector	24.17%	22.11%	49.46%	48.71%	-0.75%
The Secondary Sector	17.98%	9.88%	36.80%	21.77%	-15.03%
The Tertiary Sector	6.72%	13.40%	13.75%	29.53%	15.78%
Nonprofessional categories	51.12%	54.61%			
Shropshire	1801	1851	1801	1851	Change
The Primary Sector	25.55%	20.98%	52.47%	45.98%	-6.49%
The Secondary Sector	14.63%	11.93%	30.03%	26.14%	-3.89%
The Tertiary Sector	8.52%	12.72%	17.50%	27.88%	10.38%
Nonprofessional categories	51.30%	54.36%			
Somersetshire	1801	1851	1801	1851	Change
The Primary Sector	20.48%	17.19%	42.81%	35.64%	-7.17%
The Secondary Sector	15.68%	16.62%	32.78%	34.46%	1.68%
The Tertiary Sector	11.68%	14.42%	24.41%	29.90%	5.49%
Nonprofessional categories	52.15%	51.78%			
South Wales	1801	1851	1801	1851	Change
The Primary Sector	35.55%	22.50%	76.33%	50.77%	-25.56%

The Secondary Sector	2.76%	11.56%	5.93%	26.10%	20.16%
The Tertiary Sector	8.26%	10.25%	17.74%	23.13%	5.39%
Nonprofessional categories	53.43%	55.69%			
Staffordshire	1801	1851	1801	1851	Change
The Primary Sector	16.70%	12.32%	35.54%	27.95%	-7.59%
The Secondary Sector	21.63%	21.74%	46.04%	49.34%	3.31%
The Tertiary Sector	8.66%	10.00%	18.42%	22.70%	4.28%
Nonprofessional categories	53.01%	55.93%			
Suffolk	1801	1851	1801	1851	Change
The Primary Sector	23.31%	20.11%	47.24%	46.02%	-1.22%
The Secondary Sector	14.40%	12.22%	29.18%	27.96%	-1.22%
The Tertiary Sector	11.63%	11.37%	23.57%	26.02%	2.44%
Nonprofessional categories	50.66%	56.29%			
Surrey	1801	1851	1801	1851	Change
The Primary Sector	16.15%	14.86%	33.25%	34.36%	1.11%
The Secondary Sector	10.55%	10.20%	21.72%	23.59%	1.87%
The Tertiary Sector	21.86%	18.19%	45.02%	42.05%	-2.98%
Nonprofessional categories	51.44%	56.75%			
Sussex	1801	1851	1801	1851	Change
The Primary Sector	22.73%	16.32%	44.27%	36.61%	-7.65%
The Secondary Sector	8.19%	10.79%	15.95%	24.21%	8.26%
The Tertiary Sector	20.43%	17.46%	39.78%	39.18%	-0.60%
Nonprofessional categories	48.65%	55.43%			
Warwickshire	1801	1851	1801	1851	Change
The Primary Sector	14.08%	8.07%	29.39%	15.97%	-13.43%
The Secondary Sector	23.87%	27.81%	49.81%	55.01%	5.21%
The Tertiary Sector	9.97%	14.67%	20.80%	29.02%	8.22%
Nonprofessional categories	52.08%	49.44%			
Westmorland	1801	1851	1801	1851	Change
The Primary Sector	24.51%	22.67%	49.99%	45.17%	-4.81%
The Secondary Sector	17.52%	14.62%	35.74%	29.12%	-6.62%
The Tertiary Sector	7.00%	12.90%	14.28%	25.70%	11.43%
Nonprofessional categories	50.97%	49.81%			
Wiltshire	1801	1851	1801	1851	Change
The Primary Sector	20.07%	21.49%	41.44%	45.51%	4.06%
The Secondary Sector	22.43%	14.88%	46.31%	31.51%	-14.80%
The Tertiary Sector	5.93%	10.85%	12.25%	22.98%	10.73%
Nonprofessional categories	51.57%	52.77%			
Worcestershire	1801	1851	1801	1851	Change
The Primary Sector	14.99%	11.69%	31.27%	24.73%	-6.54%
The Secondary Sector	21.49%	21.37%	44.83%	45.20%	0.37%

The Tertiary Sector	11.45%	14.21%	23.89%	30.07%	6.18%
Nonprofessional categories	52.06%	52.73%			
Yorkshire, east	1801	1851	1801	1851	Change
The Primary Sector	19.484%	13.285%	40.11%	29.36%	-10.75%
The Secondary Sector	15.063%	14.213%	31.01%	31.41%	0.41%
The Tertiary Sector	14.033%	17.749%	28.89%	39.23%	10.34%
Nonprofessional categories	51.420%	54.752%			
Yorkshire, north	1801	1851	1801	1851	Change
The Primary Sector	22.58%	23.05%	46.03%	48.16%	2.13%
The Secondary Sector	19.25%	11.86%	39.24%	24.78%	-14.46%
The Tertiary Sector	7.23%	12.95%	14.73%	27.06%	12.33%
Nonprofessional categories	50.94%	52.14%			
Yorkshire, west	1801	1851	1801	1851	Change
The Primary Sector	14.02%	9.03%	29.11%	18.14%	-10.98%
The Secondary Sector	28.44%	31.27%	59.06%	62.79%	3.73%
The Tertiary Sector	5.70%	9.50%	11.83%	19.08%	7.25%
Nonprofessional categories	51.85%	50.20%			

Source: own calculations.

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