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

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Abstract[1]

Using the 1851 occupational census and contemporary trade directories, we show that it is possible to infer occupational structure from trade directories. Taking a stratified sample of 100 000 businesses from the *Universal British Directory*, we then 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 Shaw-Taylor *et al.*. Industrialization was broad, consistent with Temin's findings on export growth.

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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.[2] Instead, more emphasis has been placed on the role of structural change, especially the transfer of labor resources from agriculture to industry.[3] An obvious lacuna in this line of argument is that the available quantitative evidence on the rate or extent of structural change is 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 century[4]; these have formed the basis of important quantitative research.[5] 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.

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 the farm sector based on the 400 farms surveyed by Arthur Young.[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 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

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[2] Deane and Cole, *British economic growth*; Crafts and Harley, "Output growth"; Antràs and Voth, "Factor prices".
[3] Crafts, *British economic growth*.
[4] Lindert and Williamson, "Revising".
[5] Crafts, *British economic growth*.
[6] Barfoot and Wilkes, *Universal British directory*.
[7] Brunt, "Advent".

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. 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 employed in the 1851 census, and adopted here.

1. Matching the census with trade directories. The structure of the problem that we need to solve is sketched in table 1 below. We would like to be able to track occupational change over time using the census but there was no occupational census in 1801. We would therefore like to create a synthetic occupational census using some other source. Since we have trade directories in both 1801 and 1851 (and, indeed, at numerous intermediate dates), they are a potentially valuable source that we could use if we could harness them correctly.

Table 1. Data sources available to track occupational change.

1801	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. 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

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[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; see appendix 2 of this paper for a complete list. Town-level census data are reported at a slightly more aggregated level of 369 occupations. We adopt that format, for reasons that we explain in the text.

employees per business, broken down by occupation.[9] 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 locations and names of the businesses removed, which anyway are of no interest to us at this point).

Of course, it turns out to be rather more complicated that this. First, the table 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 large 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 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 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. for those firms that completed the form), but some employers randomly neglected to complete that part of the form. 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 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

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[9] See British Government, *Census of Great Britain, 1851: Population Tables II,* vol. 1, cclxxvi-cclxxix.

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 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).[10] We made the calculations in 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. 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.

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 comprised by each occupation in both the census and the trade directory. That is, work out what percentage of businesses were bakers, tailors, taverns, and so on. Now regress the trade directory distribution on the census distribution. What should you expect to find if the trade directly 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 bakers and tailors 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

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[10] 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 is reported here, 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).

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.

We undertook this exercise for our sample of seven 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 2 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 2. Regressing trade directory occupational shares on those of the census, *c*. 1851.

	Coefficient	*95% confidence interval*	r^2	*N*
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.

However, we were not content with this solution for a number of reasons. First, the table of employees per business 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 thousands. 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 1 090 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 *UBD* records businesses in several thousand distinct occupations, so if we had an employment table that covered all the 1 090 occupations reported in the 1851 census then we could aggregate the *UBD* data in such a way as to produce a national occupational census for 1801 that was exactly analogous to the national table of 1851. However, we would still face the problem that the 1851 census breaks down the data for each *town* into only 369 separate occupations. Hence any regional comparisons must necessarily be based on a coarser categorization.

We therefore pursue the following strategy. The town-level data recorded in the census is broken down into 369 occupations, as reported in table A6 in appendix 2. Now take employment in each of these occupations in each town and divide it by the number of businesses in each occupation in each town, as reported in the local trade directories. We have now generated our own table of employees per business for 369 occupations, where that set of occupations was designed by the Registrar General in 1851 to encompass all possible occupations in the economy. Apply this table of employees per business to both national and local data samples taken from the *UBD* to general an occupational census for 1801. In fact, this table conflates two effects. First, there are a certain number of employees per business. Second, there is under-registration of businesses. Suppose that there are actually two employees per baker but only half of the bakers appear in the trade directory. Then we will infer that there are four employees per baker. Is this a problem? Not necessarily, for the following reason.

We are going to use the table of employees per business for 1851 to reflate our register of businesses in 1801. This will generate our synthetic occupational census for 1801. The only thing that is important for this method to be valid is that the weights reflected in the table are stable between 1801 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 1801. This will not bias our results because the estimated employment in all occupations will be falling proportionately to one another – so our estimate of the distribution of workers across occupations will be unaffected. Suppose that establishment size is rising in all occupations: there were two bakers per bakery in 1801 but four bakers per bakery in 1851. This will 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 1801. 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 1801 and 1851. However, we can consider the likely direction of any such changes and ask in what direction our results might be biased. When we discuss our results in later sections, we show that plausible changes in establishment size would accentuate our results rather than undermine them.

Let us now turn to 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. The *UBD* additionally fulfilled some of the 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.[11] 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.[12] 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

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[11] Office of National Statistics, *Census 2001: definitions*, 23.
[12] British Government, *Census of Great Britain, 1851: Population Tables II,* vol. 1, lxxxii.

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.

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 for 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 marriage 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.[13] Clark and Hosking included a

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[13] Clark and Hosking, *Population*; Bairoch *et al.*, *Population*.

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).[14] 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 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 reflated 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.[15]

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

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[14] 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.

[15] 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.

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*.

Class	Sub-class	Occupation
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
	3	East India service
II. Persons engaged in the defense of the country	1	Army officer
		Army half-pay officer
		Soldier
		Chelsea pensioner
		Militia
	2	Navy officer
		Navy half-pay officer
		Seaman, R. N.
		Marine
		Greenwich pensioner
		Officer of naval hospital
V. Persons engaged in the domestic offices, or duties of wives, mothers, mistresses of families, children relatives	1	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
	3	Shoemaker's wife
VII. Persons who buy or sell, keep, let, or lend, money, houses, or good of various kinds	1	Shopkeeper's wife
IX. Persons possessing or working the land, and engaged in growing grain, fruits, grasses, animals, other products	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
		Tacksman
	2	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
		Almsperson
		Pauper of no stated occupation
		Lunatic of no stated occupation
	2	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 returned under the foregoing items

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 mostly comprise 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. 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 occupation is noted in appendix 2, table A5.

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 plow-making – 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.[16] The survey reveals the ratios of each of four

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[16] Young, *Six weeks' tour*; *Six months' tour*; *Farmer's tour*. Brunt, "Advent".

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).[17] 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.[18] We know also from a large sample of tax returns that the average size of a farm in 1801 was 146 acres.[19] 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 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-class 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. 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

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[17] 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).

[18] 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 take the county acreages from the 1867 agricultural returns because they are the earliest complete returns. In town-level estimates we simply assume that the agricultural workforce was zero.

[19] Allen, *Enclosure*, p. 73.

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 reflating the sample to the national scale will simply lead to a massive underestimate of the number of workers in that sector.

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

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[20] Allen, "Agriculture", 107, has 1.4 million.

[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.

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 a per-barrel bounty for the herring catch. 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, and from 1818 onwards, but very little 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 linearly interpolated the national total of ships between 1784 and 1818, giving an estimated total of 185 ships in 1801. 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, so our linear interpolation seems plausible. Most importantly, we also interpolated the tonnage per ship, which increased from 125 to 325 over the period. We then assumed that there were four tons of ship per crew member, which is the average across all the other fisheries (and in which there is surprisingly little variation). This generates an estimated employment in the whale fishery of 12 431.

Data on employment in the copper mining and ore-processing industries was likewise taken from a Parliamentary enquiry.[31] We considered the same approach with regard to the coal mining industry. But coal mining turned out to be less problematic: it was much more widespread and is well represented in the UBD. By contrast, the Parliamentary enquiries on coal mining are patchy.

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 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

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[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.

[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 nothern whale fisheries".

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

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.[32]

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.[33]

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.[34] 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

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[32] 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.

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

[34] Postmaster General, *First report*, 20.

9 000 in 1851).[35] In 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.[36] 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.[37] [38]

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.[39] 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.

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
Establishment	*1 000*	*3 794*
Town postmasters	869	9 973
CENSUS TOTAL	**1 869**	**10 410**

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

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[35] 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.

[36] Such as the list of 1783, which seems to be particularly complete. See Post Office, "Establishment of the general Post Office, 1783."

[37] 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.

[38] 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.

[39] See PO59/26.

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).[40]

There were assorted minor branches of government employment, such as "Messengers and workmen employed by the government" and "Civil servants (not in the Post Office or Revenue departments)"; see table 3 above – Class I, sub-class 1 – for a complete list. We were able to find data on the establishment of particular branches of government, such as the Audit Office.[41] But this was of little use because we were unable to find systematic data on all the branches, so summing the data that we found would lead to an underestimate of the total number of government employees. So instead we simply assumed that this group of minor occupations changed proportionately with the (overwhelmingly) largest group: dockyard workers.

The largest civilian branch of the 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.[42] 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.[43] 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.

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. 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.[44] Current guidelines state that UK civilians who

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

[41] Audit Office, "Audit Office: establishment."

[42] Moriss, *Royal dockyards*, 106.

[43] 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.

[44] Office of National Statistics, *Census 2001: definitions*, 17.

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.[45] 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).[46] 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 censuses) 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).[47] 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.[48] 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 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 may 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*.

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[45] Personal communication with the Census Office.

[46] 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.

[47] Mitchell, *Historical statistics*.

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

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	60 394
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**	**271 050**

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 1 410 inmates incarcerated on prison hulks (that is, decrepit former warships moored in the harbors of Chatham, Devonport and Portsmouth).[49] These would mostly have been French prisoners of war and were included in the original 1801 census return but disappear from the later census reports that refer to 1801. This would make some sense if English prisoners of war, who were held in France, were added instead (although it would still be factually incorrect, since they were not physically resident). In fact, no English prisoners being held abroad were added, so the population count simply falls by 1 410, which is clearly wrong.

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.[50] His figure for "Other

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[49] For a fascinating firsthand account of the machinery of British incarceration at this time, and its inhumanity, see Waterhouse, *Journal of a young man of Massachusetts*.

[50] 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*.

ranks" (that is, not officers) deployed at home is 79 732 (assuming that the artillery was deployed proportionately with the other regiments). 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.

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. We assume that all half pay officers were resident in England. 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 the deployment of each ship and its official complement.[51] This reveals that, on 1st June 1801, 325 out of 624 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 that was not true in 1801.

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.[52] 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

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[51] Admiralty, "List Book: showing the disposition of ships, names of officer & c." We thank Jeremiah Dancy for pointing this out.
[52] Admiralty, "Muster Book: showing the names of ships, their stations & c."

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 325 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 roadsted 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.[53] 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 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 46 782 men (excluding officers) serving on 1st June 1801; this compares to a notional complement of 76 943 for the same ships.

There are two ways of inferring the number of officers serving on these ships and these give similar results. First, we draw on unpublished material kindly provided to us by Jeremiah Dancy.[54] 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 seagoing vessels (3.37 per cent of and 3.12 per cent respectively), which translates to a total of 706 Royal Navy officers and 295 Royal Marines officers in the Home Fleet.[55] Second, the Admiralty List Books list the Lieutenants serving on each ship, giving 701 of them in total for the Home Fleet.[56] If Royal Marine officers were distributed evenly across the Marine Corps, then the 9 153 Marines serving in the Home Fleet were accompanied by 277 officers. These two sets of numbers for Navy and Marine officers are remarkably similar. Now reflate the 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 1 904 Royal Navy officers. Suppose that there were a further 240 officers employed ashore, such as in the Admiralty building itself and the Royal dockyards and the county recruiting offices; then we are up to 2 144 Navy officers on the home station in total.

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[53] For a nice description, see www.historyofwar.org/articles/weapons_gunboat_napoleonic.html.

[54] Dancy, "Naval manpower".

[55] Of course, we know that the actual number of serving Marine officers was 707 and we take that number in our synthetic census. But this calculation offers useful supporting evidence that the method of estimation works and that our figure for the number of naval officers serving on full pay is probably fairly accurate.

[56] Admiralty, "List Book: showing the disposition of ships, names of officer & c."

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.[57] 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 see 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 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.[58]

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 1 521 officers. Then there were around 1 600 officers on half-pay (=3 121 – 1 521).

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-

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[57] Marioné, *Complete Navy List*.

[58] 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.

pensioners and 3 086 out-pensioners.[59] In 1806, Chelsea had 476 in-pensioners and 20 805 out-pensioners.[60] We also added 35 nurses to the data base to reflect the Royal Navy medical establishment at East Stonehouse (Devonport).[61]

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 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).[62] 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).[63] 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

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[59] BPP 1806, "The fourteenth report of the Commissioners of Naval Enquiry", appendices 33 and 54.

[60] 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.

[61] BPP 1803, "Seventh report of the commissioners of naval enquiry. Naval Hospital at East Stonehouse. Le Caton hospital ship", appendix 1.

[62] 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.

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

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.[64] 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.

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 surprisingly high, twice as high as those reported by Mitchell for 1806.[65] However, there are several reasons for this and we do not believe that they are implausibly high. First, Mitchell's figures 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 warpers working with the hand-loom weavers. In that sense, his estimates are a lower bound on the true figure, especially since virtually all weavers were still using the hand-loom in 1801. Second, note 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 whom he ignores.

Mitchell cites four historical sources and takes his headline numbers from Wood.[66] 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.

[64] BPP 1806, "Twelfth report of the commissioners of naval enquiry", appendix 14.
[65] Mitchell, *Abstract*, 367.
[66] Wood, "Statistics of wages", 598; Baines, *History*; Ellison, *Cotton*; Porter, *Progress*.

Baines (citing Kennedy) makes this calculation for 1817 and 1832.[67] 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.[68] 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).

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.

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 4 above) 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 reflated the productivity change by 16/13 to adjust for this fact then we get an estimated output per worker of just 176

[67] Baines, *History*, 369-78.
[68] Ellison, *Cotton*, 55.

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).

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.[69] The increase in labor productivity that we postulate in table 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, dying, 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. 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

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[69] Baines, *History*, 201-7.

in the alternative analysis presented above) would obviously make this decline more marked. 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 nonetheless consistent with its prominence in the historiography of industrialization.

9. National occupational structure in 1801. It is difficult to summarize an employment distribution with 370 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.[70] 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 Shaw-Taylor *et al.*. The Crafts data have been used repeatedly over the last 25 years as a basis for estimating economic growth; the Shaw-Taylor *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 Shaw-Taylor *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 Shaw-Taylor *et al.* state very clearly in their numerous papers – is that their data pertain to males only.[71] 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.

	1800 *(Crafts)*	*1801* *(Brunt-Meidell)*	*1817* *(Shaw-Taylor* **et al.***)*	*1851* *(Census)*
Primary	40	38	38	28
Secondary	30	31	42	41
Tertiary	30	31	19	32

Sources: 1800 – Crafts, *British industrialization*, p. ; 1801 – see text; 1817 – Shaw-Taylor et al., "Occupational structure", 10. Note that the data provided by Shaw-Taylor *et al.* pertain only to male employment and are therefore not directly comparable with the other data. We address this issue in detail in the text below. 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 Shaw-Taylor *et al.* seems to paint a very different picture of the rate of industrialization to that proposed by Crafts (and, later, Crafts and Harley).[72] Shaw-Taylor *et al.* find no trace of industrialization in the early nineteenth century – indeed there are some signs of deindustrialization. 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.

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[70] Wrigley, "PST system".
[71] Kitson *et al.*, "Creation of a 'census'".
[72] Crafts and Harley, "Output growth".

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 Shaw-Taylor, and still a marked growth in industrial employment.

Table 10. Comparison of adjusted estimates of occupational structure.

	1800 (Crafts)	*1801 (Brunt-Meidell)*	*1801 (adjusted Brunt-Meidell)*	*1817 (adjusted Shaw-Taylor et al.)*	*1817 (Shaw-Taylor et al.)*	*1851 (Census)*
Primary	40	38	*39*	*34*	39	28
Secondary	30	31	*32*	*37*	42	41
Tertiary	30	31	*29*	*29*	19	32

Sources: as table 6 and described in the text.

Second, how can we explain the apparent decline in industrial employment between 1817 and 1851? Shaw-Taylor *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.[73] 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 Shaw-Taylor *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).

Overall, we do not find any glaring inconsistencies between our data and those of Shaw-Taylor *et al.*. Adjusting our data for the effect of the Napoleonic Wars, and plausibly adjusting their data for the absence of women, reveals two estimates of occupational structure that are quite similar. Since the two estimates anyway pertain to benchmark years that are 16

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[73] 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 comprises the majority of females in the population.

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. But this is perfectly consistent significant growth in the commercial (i.e. non-military) part the service sector between 1801 and 1851. We also believe that our estimates are 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 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. Note that 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 Shaw-Taylor *et al.* and make industrialization more rapid. By contrast, consider the primary weakness of Shaw-Taylor *et al.*'s approach. They exclude women from their analysis. Since women were disproportionately engaged in the service sector, this biases upwards the apparent importance of industry in total employment and it is reasonable to regard their estimate as an upper bound also. Since our upper bound is already lower than theirs, our data give a "tighter" characterization of employment in the English economy in the early nineteenth century. Refining their technique by incorporating women would move their estimate of the share of industry closer to ours, again making industrialization more rapid.

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

Industry	Change in share	Change in employment
Agriculture	-12.0%	423 749
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 12 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 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 12. The biggest winners, in terms of their share in total employment, 1801-51.

Industry	Change in share	Change in employment
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 marriage 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 Shaw-Taylor 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 woolen 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.[74] 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

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[74] 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.

point in the period 800 to 1850.[75] 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.[76] 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 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

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[75] 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.

[76] 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.

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 Hoskings 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	-1998.26
	(885.26)	(1578.94)
Clark and Hosking 1811 population	1.01**	2.39**
	(0.08)	(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.[77] 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.[78] 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.

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

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[77] 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.

[78] 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.

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.

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.

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.[79] 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.

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.

Table A3. English parish and urban populations, 1811.

Town	Cty	Parish	Urban	Town	Cty	Parish	Urban
Ampthill	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*

[79] 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 Edgeware, Staines, Twickenham, Abegavenny, Chepstow, Monmouth, Beaumaris, Denbigh, Montgomery, Brecon and Kidwelly from the 1831 census.

Place				Place			
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*	Grimsby	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*	Brancaster	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

Place				Place			
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*	Stogumber	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**

Town	Col2	Col3	Col4	Town	Col6	Col7	Col8
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*

Place	Col	Val1	Val2	Place	Col	Val1	Val2
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*

Place				Place			
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*	Aldborough	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
Eccleston	19	19738	1584	Halifax	43	73415	9159

Town	Cty			Town	Cty		
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.

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.
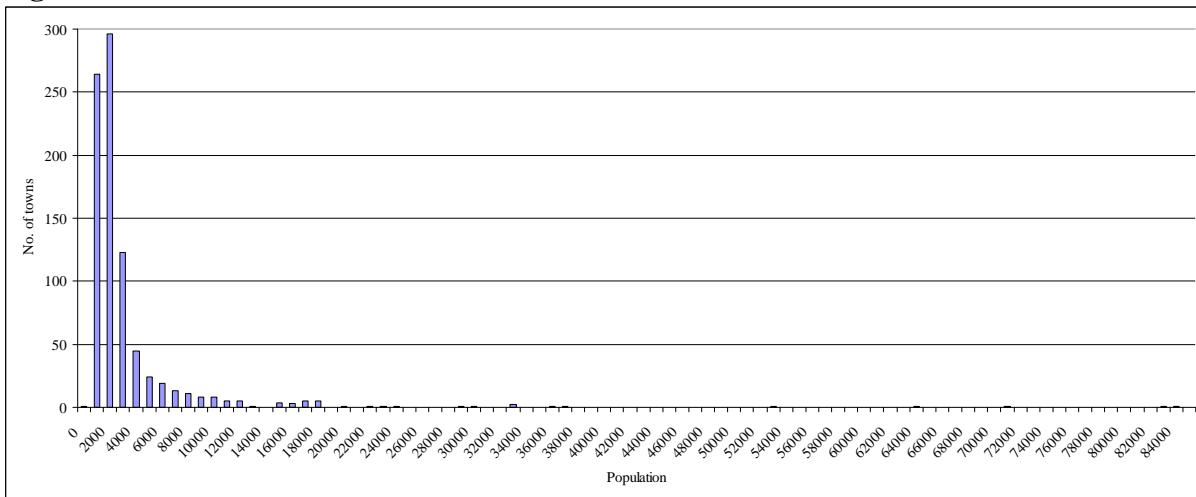
In fact, the extensive literature on the size distribution of towns shows that this skewness is a common feature of the pattern of urbanization, with towns in many countries and time periods approximating a power rule known as Zipf's Law.[80] Interestingly, eighteenth century English towns also obeyed 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).[81] 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

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[80] Kwok Tong Soo, "Zipf's Law".

[81] 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".

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	64	6
2 251 to 4 500	133	7
1 226 to 2 250	258	8
613 to 1 225	229	9
0 to 612	123	10
TOTAL	**856**	

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 (Ampthill) 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 Edgeware, Staines and Twickenham to represent Middlesex. (Almost all of the Middlesex towns reported in the *UBD*, such as Chelsea and Islington, had *de facto* already been swallowed by the London conurbation by the early 1800s. We therefore chose Edgeware, Staines and Twickenham because they were still genuinely outside the capital.[82])

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). This gives 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 A5: 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 A5. 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**	*Leighton Buzzard* *Luton*	**Ampthill** Biggleswade Dunstable Potton Toddington Woburn	*Shefford*
Berks		**Reading**		**Abingdon** Maidenhead Newbury Wantage Windsor	**Faringdon** Wallingford Wokingham	**Hungerford** Lambourn	*East Ilsley*
Bucks				**Amersham**	**Aylesbury**	**Beaconsfield**	

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[82] Clout, *Times London history atlas*, 74-5.

County							
				Chesham Colnbrook High Wycombe	Buckingham Eton Newport Pagnell	Great Missenden Ivinghoe PrincesRisborough Stony Stratford Wendover Winslow	
Cambs		**Cambridge**	**Ely**	**March** Whittlesey Wisbech	**Chatteris** Littleport Soham Thorney	*Linton*	**Caxton**
Ches		**Chester** **Macclesfield** **Stockport**	**Congleton**	**Nantwich** Sandbach	**Frodsham** Knutsford Middlewich Neston Northwich Over	**Halton** Maplas Tarvin	
Cornwall				**Helston** Penryn Penzance Redruth Truro	**Bodmin** Camborne Falmouth Launceston Liskeard Millbrook Saltash St Austell St Ives	**Fowey** Marazion Mevagissey Mitchell Padstow St Columb Major St Germans St Mawes Wadebridge	**Boscastle** Bossiney Callington Camelford East Looe Grampound Lostwithiel Stratton Tregony West Looe
Cumb		**Whitehaven**	**Carlisle** **Workington**	**Alston Moor** Cockermouth Maryport Penrith Wigton	*Abbey Town* **Brampton** Keswick Longtown	**Egremont** Harrington Kirkoswald	**Bootle** *Ireby* *Ravenglass*
Derbys		*Belper* **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	**Abbotsbury** Bere Regis Cerne Abbas Stalbridge SturminsterNewton Swanage	*Chideock* **Evershot** Frampton Milton Abbas

County							
Durham	**Sunderland**	*South Shields*	**Darlington** **Durham**	**BarnardCastle**	*Bishop Auckland* **Chester le Street** Gateshead HoughtonleSpring Stanhope	**Monkwearmouth** Staindrop	**Hartlepool** Stockton Wolsingham
Essex		**Colchester**	*West Ham*	*Barking* **Chelmsford** WalthamAbbey	*Bocking* *Braintree* **Brentwood** Coggeshall Epping Great Dunmow Halstead Harwich Maldon Romford Saffron Walden Witham	**Billericay** Burnham Dedham Grays Thurrock Harlow Hatfield Broad Oak Manningtree Rayleigh Rochford Thaxted	*Chipping Ongar* *Great Bardfield* **Horndon** St Osyth
Gloucs			**Gloucester**	**Cheltenham** **Stroud**	**Bisley** Cirencester Coleford Dursley Minchinhampton Painswick Tewkesbury Wotton-under-Edg	**Berkeley** Blockley Chipping Campden Chipping Sodbury Fairford Marshfield Newent Northleach Stow-on-the-Wold Tetbury Thornbury Winchcombe	**Lechlade** Leonard Stanley Lydney Mitcheldean Moreton-in-Mar Newnham Wickwar
Hants	**Portsmouth**		**Gosport** **Southampton** **Winchester**	**Christchurch** Fareham Fordingbridge Newport	**Alton** Andover Basingstoke Lymington Odiham Petersfield Ringwood Romsey Titchfield West Cowes	**Bishops Waltham** Havant Kingsclere New Alresford Whitchurch	*Bournemouth* *Newtown* Stockbridge Yarmouth
Hereford			**Hereford**	**Ledbury** Leominster	*Kington* *Ross-on-Wye*	**Bromyard** Pembridge	*Weobley*
Herts				**H Hempstead** Hertford	**BishopsStortford** Cheshunt Hatfield Hitchin Hoddesdon Rickmansworth St Albans Tring Ware Watford	**Baldock** Barnet Berkhampsted Buntingford Royston Sawbridgeworth Standon Stevenage Welwyn	*Ashwell*
Hunts						**Godmanchester** Huntingdon Kimbolton Ramsey St Ives St Neots Yaxley	
Kent		**Deptford** **Dover** **Greenwich** *Woolwich*	**Canterbury** **Chatham** **Deal** *Gillingham* **Maidstone** **Margate** **Rochester** *Tunbridge Wells*	**Bromley** Cranbrook Dartford Faversham Folkestone Gravesend Ramsgate Sandwich Tenterden Tonbridge	**Ashford** Bexley Eltham Goudhurst Hawkhurst Hythe Lenham Lydd Milton Regis Northfleet Sevenoaks Strood	**West Malling** New Romney Queenborough Sittingbourne Smarden St Mary Cray Wye	*Fordwich*

County							
					Westerham Whitstable Wrotham		
Lancs	*Salford*	**Ashton u Lyne** **Blackburn** **Bolton** *Oldham* **Preston** *Tameside* **Warrington** **Wigan**	**Bury** **Colne** **Haslingden** **Lancaster** **Rochdale** *South Ribble* *St Helens*	*Atherton* **Burnley** Ormskirk Prescot Sefton Ulverston	**Cartmel** Chorley Clitheroe Eccleston Kirkham Leigh Newton-le-Willows Ribchester	*Broughton* **Dalton-in-Furness** Garstang Hawkshead Kirkby Poulton Widnes	**Hornby**
Leics		**Leicester**	**Hinckley** **Loughborough**	**Ashby de la Z**	*Castle Donington* **Lutterworth** MarketHarborough Melton Mowbray Mountsorrel	**Market Bosworth**	*Billesdon* *Hallaton* *Waltham on W*
Lincs			**Boston** **Gainsborough** **Lincoln** **Louth**	**Grantham** Holbeach Spalding Stamford	**Barton upon H** Bourne Brigg Crowland Crowle Donington Epworth Grimsby Horncastle Kirton Sleaford	**Alford** Burgh le Marsh Caistor Market Deeping Market Rasen Spilsby Wainfleet	**Binbrook** Bolingbroke Burton upon Sta Folkingham Market Stainton Panton Saltfleet Tattershall Torksey
Midx Mmouth Norfolk		**Great Yarmouth** **King's Lynn**		**Staines** **Monmouth** **East Dereham**	**Twickenham** **Abergavenny** **Diss** Swaffham Thetford Wells-next-the-Se Wymondham	**Edgeware** **Chepstow** **Attleborough** Aylsham Downham Fakenham Harleston Hingham Holt Kenningham Little Walsham North Walsham	*Brancaster* *BurnhamMarket* **Castle Rising** Cley next the S Cromer East Harling Foulsham Litcham Loddon Methwold NewBuckenham Reepham Setchey Snettisham Watton Worstead
Northants			**Northampton**	**Daventry** Kettering Peterborough Wellingborough	**Brackley** Oundle Rothwell Towcester	*Higham Ferrers* *King's Cliffe* **Thrapston**	*Rockingham*
Northumb	**Newcastle**		*North Shields* *Tynemouth*	**Berwick-upon-** Hexham Morpeth	**Allendale** Alnwick Blyth	**Corbridge** Haltwhistle Rothbury Wooler	**Bellingham**
Notts	**Nottingham**				**Mansfield** Newark-on-Trent	*Blyth* **Southwell** Worksop	**Bingham** East Retford Tuxford
Oxon		**Oxford**		**Banbury** Henley-on-Tha Witney	**Bampton** Bicester Burford Chipping Norton Deddington Thame	*Dorchester* *Watlington* **Woodstock**	
Rutland					**Oakham** Uppingham		
Salop		**Shrewsbury**		**Ellesmere** Madeley Oswestry Wellington Whitchurch	**Bishop's Castle** Bridgnorth Brosely Ludlow Market Drayton Shifnal	**CleoburyMortimer** Clun Much Wenlock Newport	**ChurchStretton**

County							
Somerset	**Bath**		**Frome** **Taunton**	**Bridgwater** Chard Crewkerne SheptonMallett Wellington Wells Yeovil	Wem **Beckington** Bruton Castle Cary Glastonbury Ilminster Keynesham Milverton North Petherton Somerton South Petherton Watchet Wincanton Wiveliscombe	**Axbridge** Dulverston Dunster Ilchester Langport Milborne Port Minehead North Curry Pensford Porlock Stogumber	*Nether Stowey* **Norton StPhilip** Wrington
Staffs	**Stoke-on-T**	*Sedgley* **Wolverhampton**	**Bilston** **Burslem** *Rowley Regis* **Walsall**	**Burton upon T** Darlaston Leek Lichfield Newcastle Stafford Stone Tamworth Wednesbury West Bromwich	**Brewood** Cheadle Penkridge Rugeley Uttoxeter	*Abbots Bromley* **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				*Elmbridge* **Farnham**	**Croydon**	**Chersey** Godalming Kingston Richmond	*Bletchingley* **Dorking** Egham Epsom Guildford Haslemere Leatherhead Putney Reigate Woking
Sussex				**Brighton** Chichester Lewes	**Hastings** Horsham	**Arundel** Battle Burwash Cuckfield East Grinsted Eastbourne Petworth Rye Wadhurst Worthing	*Ditchling* *Hailsham* **Midhurst** Seaford Shoreham-by-S Steyning Storrington West Tarring Winchelsea
Warwicks		**Coventry**		**Atherstone** Nuneaton Stratford-upon- Warwick	**Alcester** Bedworth Kenilworth Rugby Solihull Sutton Coldfield	**Coleshill** Henley-in-Arden Kineton Polesworth Southam	
			Kendal		**Kirkby Lonsdale** Kirkby Stephen	**Ambleside** Appleby Brough Orton	**Burton-in-Kend**
Wilts			**Salisbury**	**Bradford on A** Trowbridge	**Calne** Chippenham Devizes	**Corsham** Cricklade Downton	*Aldbourne* **Amesbury** Heytesbury

					Marlborough Melksham Warminster Westbury	East Lavington Great Bedwin Malmesbury Mere Ramsbury Wilton Wootton Bassett	Highworth Hindon Ludgershall Swindon
Worcs		**Worcester**	**Dudley** **Kidderminster**	**Bewdley** Bromsgrove Stourbridge	**Evesham** Pershore UptonuponSevern	**Droitwich** Shipston-on-Stour Tenbury Wells	
ERYorks	**Kingston**		**Beverley**	**Bridlington**	**Great Driffield** Howden Market Weighton Pocklington	**Hedon** Hornsea Hunmanby Kilham Patrington	*Frodingham*
NRYorks		**York**	**Scarborough** **Whitby**	**Pickering**	**Easingwold** Guisborough Helmsley Kirkbymoorside Malton Northallerton Richmond Stokesley Thirsk	*Askrigg* **Bedale** Masham Yarm	*Middleham*
WRYorks	**Sheffield**	**Huddersfield**	*Almondbury* **Barnsley** *Bingley* Bradford *Dewsbury* Doncaster Halifax Knaresborough Wakefield	*Batley* **Keighley** Otley Pontefract Ripon Rotherham Skipton Slaithwaite Tadcaster	*Dalton* *Harrogate* **Mirfield** Pateley Bridge Sedbergh Selby Tickhill	**Aberford** Bawtry Boroughbridge Settle Sherburn in Elmet Snaith Thorne Wetherby	*Aldborough* **Cawood** Gisburn Ripley
NWales			**Denbigh**	**Newtown**	**Montgomery**	**Beaumaris**	
SWales			**Merthyr-Tydfil** *Ogwyr* **Swansea**		**Cardiff**	**Brecon** Llangadack	**Kidwelly**

Appendix 2. The synthetic occupational census for 1801.

Table A6. National occupational classification for 1801.

Class	Sub-class	Occupation	ID	N
I	1. National government	Post Office	1	8 661
		Inland Revenue	2	4 843
		Customs	3	9 550
		Other government officers	4	14 571
	2. Local government	Police	5	3 218
		Union relieving officer	6	681
		Office of local board	7	682
		County, local, -officer (not otherwise distinguished)	8	4 160
	3. East India government	East India Service	9	1 711
II	1. Army – at home	Army officer	10	4 034
		Army half-pay officer	11	2 429
		Soldier	12	79 732
		Chelsea pensioner	13	20 712
	2. Navy – ashore or in port	Navy officer	14	2 421
		Navy half-pay officer	15	2 038
		Seaman, R.N.	16	46 782
		Greenwich pensioner	17	5 349
		Marine	18	9 153
		Others engaged in defence	19	213
III	1. Clergymen and ministers	Clergyman	20	52 113
		Protestant minister (not otherwise described)	21	3 709
		Priest of other religious bodies	22	1 169
	2. Lawyers	Barrister, advocate, special pleader, conveyancer	23	356
		Solicitor, attorney, writer to signet	24	1 964

		Other lawyers	25	57
	3. Physicians and surgeons	Physician	26	924
		Surgeon, apothecary	27	1 170
		Other medical men	28	45
	4. Church officers	Parish clerk, clerk to church	29	1 203
		Other union, district, parish officer	30	114
	5. Law clerks, court officers, stationers	Law clerk	31	7 150
		Law stationer	32	1 192
	6. Chemists, surgical instrument makers	Druggist	33	837
		Others dealing in drugs	34	4
IV	1. Authors	Author	35	206
		Editor, writer	36	145
		Others engaged in literature	37	1
	2. Artists	Painter (artist)	38	56
		Architect	39	50
		Others engaged in the fine arts	40	12
	3. Scientific persons	Scientific person, observatory and museum keeper, naturalist, etc.	41	226
	4. Teachers	Music-master	42	70
		Schoolmaster, schoolmistress	43	30 078
		Governess	44	10 235
		Other teachers	45	83
V	1. Wives	Wife (of no specified occupation)	46	1161869
	2. Widows	Widow (of no specified occupation)	47	119 073
	3. Children	Son, grandson, brother, nephew (not otherwise returned)	48	878 958
		Daughter, grand-daughter, sister, niece (not otherwise returned)	49	1203250
		Scholar – under tuition at home	50	24 781
	4. Scholars	Scholar – under tuition at school or college	51	1147386
VI	1. In boarding and lodging	Innkeeper	52	7 619
		Innkeeper's wife	53	4 640
		Lodging-house keeper	54	17
		Officer of charitable institution	55	721
		Others – boarding and lodging	56	109
	2. In attendance (domestic servants, etc.)	Domestic servant (general)	57	331 401
		Housekeeper	58	23 802
		Cook	59	22 456
		Housemaid	60	25 454
		Nurse	61	18 337
		Inn servant	62	16 008
		Nurse at hospital, etc.	63	11 404
		Midwife	64	1 033
		Charwoman	65	27 396
		Coachman	66	3 587
		Groom	67	7 785
		Gardener (servant)	68	2 301
	3. In providing dress	Hairdresser, wig-maker	69	2 751
		Hatter	70	2 158
		Straw hat, bonnet, -maker	71	13 108
		Furrier	72	51
		Tailor	73	14 026
		Cap, -maker, dealer	74	214
		Milliner, dressmaker	75	19 478
		Shirtmaker, seamster	76	30 311
		Shawl manufacturer	77	149
		Staymaker	78	4 443
		Hosier, haberdasher	79	1 042
		Hose (stocking) manufacture	80	30 066
		Laundry-keeper, mangler	81	14 205
		Rag, -gatherer, dealer	82	40
		Glover (material not stated)	83	116 489
		Shoemaker, bootmaker	84	22 226
		Shoemaker's wife	85	7 497
		Patten, clog, -maker	86	336
		Umbrella, parasol, stick, -maker	87	85
		Others providing dress	88	5 760
VII	1. Buy, sell, let, lend goods or money	House proprietor	89	14 667
		Merchant	90	1 867
		Banker	91	2 309
		Ship-agent	92	54
		Broker	93	561
		Agent, factor	94	185

		Salesman, saleswoman	95	257
		Auctioneer, appraiser, valuer	96	366
		Accountant	97	335
		Commercial clerk	98	951
		Commercial traveller	99	4 265
		Pawnbroker	100	186
		Shopkeeper (branch undefined)	101	1 065
		Shopkeeper's wife	102	232
		Hawker, pedlar	103	21 679
		Other general merchants, dealers, agents	104	1 623
VIII	1. Railways	Railway engine, -driver, stoker	105	0
		Others engaged in railway traffic	106	0
	2. Roads	Toll collector	107	272
		Coach and cab owner	108	109
		Livery-stable keeper	109	41
		Coachman (not domestic servant), guard, postboy	110	794
		Carman, carrier, carter, drayman	111	18 412
		Omnibus, -owner, conductor	112	0
		Others engaged in road conveyance	113	163
	3. Canals	Canal and inland navigation service	114	818
		Boat and bargeman	115	55 551
		Others connected with inland navigation	116	11 258
	4. Seas and rivers	Shipowner	117	34
		Seaman (merchant service)	118	123 051
		Pilot	119	100
		Others connected with sea navigation	120	869
	5. Warehousemen and storekeepers	Warehouseman	121	3 743
		Others connected with storage	122	98
	6. Messengers and porters	Messenger, porter (not government), errand-boy	123	5 351
		Others employed about messages	124	30
IX	1. In fields and pastures	Land proprietor	125	30 315
		Farmer	126	185 372
		Grazier	127	7 415
		Farmer's, grazier's wife	128	123 554
		Farmer's, grazier's son, grandson, brother, nephew	129	83 839
		Farmer's, grazier's daughter, grand-daughter, sister, niece	130	78 917
		Farm bailiff	131	8 163
		Agricultural labourer (outdoor)	132	667 083
		Shepherd	133	9 675
		Farm servant (indoor)	134	309 617
		Others connected with agriculture	135	1 386
	2. In woods	Woodman	136	6 007
		Others connected with arboriculture	137	120
	3. In gardens	Gardener	138	2 380
		Nurseryman	139	139
		Others connected with horticulture	140	0
X	1. Persons engaged about animals	Horse-dealer	141	790
		Groom (not domestic servant), horse-keeper, jockey	142	13 985
		Farrier, veterinary surgeon	143	855
		Cattle, sheep, dealer, salesman	144	100
		Drover	145	1 516
		Gamekeeper	146	3 848
		Vermin-destroyer	147	884
		Fisherman	148	18 789
		Others engaged about animals	149	145
XI	1. In books	Bookseller, publisher	150	588
		Bookbinder	151	287
		Printer	152	1 079
		Others engaged about publications	153	60
	2. In plays (actors)	Actor	154	621
		Others engaged about theatres	155	0
	3. In music	Musician (not teacher)	156	18 040
		Musical instrument, -maker, dealer	157	37
		Others connected with music	158	46
	4. In pictures and engravings	Engraver	159	129
		Others employed about pictures and engraving	160	84
		Others employed about figures and carving	161	54
	5. In carving and figures	Artificial flower maker	162	1 490
	6. In shows and games	Toy, -maker, dealer	163	138
		Persons connected with shows, games and sports	164	0

	7. In plans and designs	Civil engineer	165	1 315
		Pattern designer	166	808
		Other designers and draughtsman	167	304
	8. In medals and dies	Medallist and medal-maker	168	240
	9. In watches, philosophical instruments	Watchmaker, clockmaker	169	2 368
		Philosophical instrument maker	170	139
	10. In arms	Gunsmith	171	441
		Others engaged in the manufacture of arms	172	100
	11. In machines	Engine and machine maker	173	2 263
		Tool-maker	174	484
		Others dealing in tools and machines	175	623
	12. In carriages	Coachmaker	176	980
		Others connected with carriage making	177	0
	13. In harness	Saddler, harness-maker	178	2 214
		Whip-maker	179	91
		Other harness-makers	180	0
	14. In ships	Shipwright, shipbuilder	181	5 920
		Boat, barge, -builder	182	353
		Others engaged in fitting ships	183	408
	15. In houses	Surveyor	184	209
		Builder	185	413
		Carpenter, joiner	186	25 436
		Bricklayer	187	11 124
		Mason, pavior	188	9 601
		Slater	189	653
		Plasterer	190	2 545
		Painter, plumber, glazier	191	8 380
		Others engaged in house construction	192	7
	16. In implements	Wheelwright	193	1 832
		Millwright	194	1 429
		Other implement makers	195	46
	17. In chemicals	Dyer, scourer, calenderer	196	1 737
		Others engaged in manufacture of chemicals	197	1 309
XII	1. In animal food	Cowkeeper, milkseller	198	464
		Cheesemonger	199	347
		Butcher, meat salesman	200	6 018
		Butcher's wife	201	2 356
		Provision curer	202	4
		Poulterer, gamedealer	203	35
		Fishmonger, dealer, seller	204	326
		Others dealing in animal food	205	184
	2. In grease, bone, horn, ivory, intestines	Soap-boiler	206	858
		Tallow-chandler	207	3 210
		Comb-maker (for manufactures)	208	191
		Others dealing in grease and bones	209	73
	3. In skins	Fellmonger	210	447
		Skinner	211	818
		Currier	212	3 706
		Tanner	213	8 216
		Other workers in leather	214	330
	4. In feathers and quills	Feather, -dresser, dealer	215	3
	5. In hair and fur	Hair, bristle, -manufacture	216	438
		Brush, broom, -maker	217	349
		Other workers, dealers in hair	218	896
	6. In wool	Woolstapler	219	2 802
		Knitter	220	1 290
		Woollen cloth manufacture	221	206 117
		Fuller	222	740
		Worsted manufacture	223	12 525
		Stuff manufacture	224	11 575
		Clothier	225	20 755
		Woollen draper	226	327
		Carpet, rug, -manufacture	227	13 700
		Other workers, dealers in wool	228	3 316
	7. In silk	Silk manufacture	229	4 041
		Silkmercer	230	46
		Ribbon manufacture	231	5 140
		Fancy goods manufacture	232	930
		Embroiderer	233	1 281
		Other workers, dealers in silk	234	422

XIII	1. In vegetable food	Greengrocer	235	70
		Corn merchant	236	419
		Miller	237	1 936
		Flour-dealer	238	225
		Baker	239	4 954
		Confectioner	240	527
		Others dealing in vegetable food	241	758
	2. In drinks and stimulants	Maltster	242	4 109
		Brewer	243	8 449
		Licensed victualler, beershopkeeper	244	7 650
		Licensed victualler, beershopkeeper's wife	245	4 447
		Wine and spirit merchant	246	1 311
		Sugar-refiner	247	13
		Grocer	248	9 062
		Tobacconist	249	188
		Others dealing in drinks, stimulants	250	1 196
	3. In gums and resins	Oil and colourman	251	83
		French-polisher	252	1 571
		Other workers, dealers in oils, gums, etc.	253	304
	4. In timber	Timber merchant	254	538
		Other dealers, workers in timber	255	57
	5. In bark	Cork-cutter	256	211
		Others dealing in bark	257	5
	6. In wood	Sawyer	258	1 584
		Lath-maker	259	80
		Other wood workers	260	43
	7. In wood furniture	Cabinet-maker, upholsterer	261	4 345
		Turner	262	827
		Chair-maker	263	378
		Box-maker	264	35
		Others dealing in wood furniture	265	34
	8. In wood utensils	Cooper	266	3 629
		Other makers of wood utensils	267	0
	9. In wood tools	Frame-maker	268	757
		Block and print cutter	269	387
		Other wood tool makers	270	202
	10. In cane, rush and straw	Basket-maker	271	729
		Thatcher	272	3 004
		Straw plait manufacture	273	14 013
		Other workers in cane, rush, straw	274	26
	11. In hemp	Ropemaker	275	1 131
		Sailcloth manufacture	276	1 954
		Others working in hemp	277	2 330
	12. In flax, cotton	Flax, linen, -manufacture	278	145 400
		Thread manufacture	279	430
		Weaver (material not stated)	280	0
		Draper	281	40 919
		Lace manufacture	282	5 088
		Cotton manufacture	283	235 755
		Lint manufacture	284	2
		Packer and presser (cotton)	285	1
		Fustian manufacture	286	2 809
		Muslin embroiderer	287	31
		Calico, cotton, -printer	288	6 173
		Calico, cotton, -dyer	289	1 662
		Other workers, dealers in flax, cotton	290	993
	13. In paper	Paper manufacture	291	994
		Stationer	292	369
		Paper-stainer	293	135
		Paper-hanger	294	6
		Other paper workers, dealers	295	36
XIV	1. In coal	Coal-miner	296	79 871
		Coal, -merchant, dealer	297	402
		Coal, -heaver, labourer	298	6 636
		Chimney-sweeper	299	26
		Gasworks service	300	0
		Other workers, dealers in coal	301	278
	2. In stone, clay	Stone-quarrier	302	436
		Slate-quarrier	303	3 756
		Limestone, -quarrier, burner	304	518

		Marble mason	305	550
		Brick, -maker, dealer	306	1 737
		Road labourer	307	4 047
		Railway labourer	308	0
		Other workers in stone, lime, clay	309	1 027
	3. In earthenware	Earthenware manufacture	310	28 775
		Earthenware and glass dealer	311	516
		Tobacco-pipe maker	312	213
	4. In glass	Glass manufacture	313	633
		Other workers, dealers in glass	314	221
	5. In salt	Salt, -agent, merchant, dealer	315	214
	6. In water	Water, -carrier, dealer	316	844
	7. In precious stones	Workers, dealers in precious stones	317	42
	8. In gold and silver	Goldsmith, silversmith	318	1 43
		Plater	319	586
		Carver, gilder	320	157
		Other workers, dealers in gold and silver	321	1 670
	9. In copper	Copper-miner	322	5 500
		Copper manufacture	323	4 500
		Coppersmith	324	287
		Other workers, dealers in copper	325	196
	10. In tin	Tin-miner	326	6 588
		Tinman, tin-worker, tinker	327	7 017
		Other workers, dealers in tin	328	4 839
	11. In zinc	Zinc manufacture	329	225
		Other workers and dealers in zinc	330	14
	12. In lead	Lead-miner	331	10 220
		Lead manufacture	332	10
		Other workers, dealers in lead	333	437
	13. In brass and mixed metals	Brass, -manufacture, founder, moulder	334	728
		Locksmith, bellhanger	335	1 019
		Brazier	336	5 578
		White metal manufacture	337	316
		Pin manufacture	338	83
		Button-maker (all branches)	339	480
		Wire, -maker, drawer	340	84
		Wire, -worker, weaver	341	167
		Other workers, dealers in mixed metals	342	3 079
	14. in iron and steel	Iron-miner	343	9 889
		Iron, manufacture, moulder, founder	344	6 973
		Whitesmith	345	3 616
		Blacksmith	346	8 018
		Nail manufacture	347	4 337
		Anchorsmith, chainsmith	348	174
		Boiler-maker	349	3 072
		Ironmonger	350	1 405
		File-maker	351	137
		Cutler	352	519
		Needle manufacture	353	1 758
		Grinder (branch undefined)	354	31
		Other workers, dealers in iron, steel	355	2 496
XV	1. Labourers (branch undefined)	Labourer (branch undefined)	356	169 288
	2. Other persons of indefinite employ	Mechanic, manufacturer, shopman, shopwoman	357	111 011
	3. Others of indefinite occupations	Others of indefinite occupations	358	984
XVI	1. Other persons of rank or property	Gentleman, gentlewoman, independent	359	12 929
		Annuitant	360	63 562
		Others of independent means	361	86
XVII	1. Living on income from other sources	Dependent on relatives (not classed elsewhere)	362	7 958
		Almsperson	363	4 190
		Pauper of no stated occupation	364	40 953
		Lunatic of no stated occupation	365	4 056
		Others supported by the community	366	198
	2. Prisoners (of no stated occupation)	Prisoner of no stated occupation	367	1 490
	3. Vagrants (of no specified occupation)	Vagrant in barns, tents, etc.	368	9 340
		Persons of no stated occupations or conditions and persons not returned under the foregoing items	369	79 964
		TOTAL		

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