100 Years of the UK Census of Production

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Abstract

The first Census of Production in the UK was taken for 1907. To mark the centenary we review the evolution of the Census, considering the changes that have taken place and the pressures which have given rise to them. This evolution has led from an approximately five-yearly census which took several years to process to an annual census, then to the introduction of sampling techniques, and in recent years ever greater pressure for centralisation, more outputs from the same sample sizes, and improved quality.

We will briefly consider some of the challenges in making consistent series of historic information over such a long period, and draw out lessons which can be learned from the past. We will use these to suggest how the development of the "Census of Production" (in its present form integrated with annual collections of data on service industries as the Annual Business Inquiry) will continue.

Keywords: survey development; statistical legislation; respondent burden; survey history

1. Introduction

There are many statistical collections which have been run by National Statistical Institutes for long periods. Usually they have developed continuously, with a gradual accretion of changes leading to the current approach. By reviewing the way in which these developments have been introduced, we can see patterns which help us to interpret the methods in a range of surveys. We can begin to understand why the survey has evolved to have a particular form. How often have you asked the staff of a survey "Why do we do that?", only to receive the response "We've always done it that way"? It can also help to resurrect ideas which have been tried at a particular stage of the survey's development but not introduced, as they may be more relevant when conditions or technologies change.

We will illustrate these themes from an investigation of the history of the Census of Production in the UK, which has its centenary in 2007. In looking back over the development of the Census we have come across a store of useful knowledge and generalisable trends in developments. A detailed history of the development of the Census of Production is available in Smith & Penneck (2007).

2. Quinquennial Censuses

2.1 Getting Started

The impetus for the first economic census in the UK, the Census of Production 1907, came from tariff policy – to enable domestic production levels to be compared with the value of imports. The UK was a latecomer to a census of production – a hundred years later than the USA, for example. The Census Bill was proposed by the government and (unusually for this type of Bill) had support from the opposition, but there was deep suspicion from manufacturers, and concern from individual MPs about manufacturers losing their trade secrets. The initial Census of Production Bill included powers to require businesses to provide a wide range of data, but concessions were needed to get it passed by Parliament, and the resulting Census of Production Act 1906 severely limited the amount of data that could be statutorily collected. The first censuses focused on statistics of output and employment.

The first Census of Production was in respect of 1907, and was carried out by the Board of Trade. It covered all businesses, including the smallest. Special Advisory Committees were set up to devise a suitable questionnaire for each industry, and these added further, voluntary questions on a range of topics. All the data collection was through postal questionnaires, and the follow-up was also by post, which contributed to a very long processing time. Some provisional results were released quite early on, but the full report didn't appear until 1912.

In the UK there have been only two pieces of primary legislation specifically targeted at statistical collections of economic data – the Census of Production Act 1906, and the Statistics of Trade Act 1947; the Statistics and Registration Services Act 2007 has also recently passed, the only other Act primarily about statistics, although it does not alter the collection powers. The first general principle from the development of the Census comes from this – it is often very difficult to start up a new collection, particularly if legislation is required. The corollary is that maximum use will be made of what legislation there is, both in terms of coverage of that legislation (as

demonstrated by the gradually widening remit from the Census of Production (1907) to surveys of businesses (1947) to the UK official statistics system (2007)), and in using the legislation once it has been passed to get the best collections possible.

Despite the restriction on topics, the information from the first Census was of considerable value – as well as helping the government with tariff policy, it also provided the basis for the first estimate of National Income (a forerunner of gross domestic product) according to the output measure (Flux 1912). There had been debate about the periodicity of the Census, but an approximately five-yearly pattern was used up to the Second World War, although interrupted by the First World War.

2.2 Costs (and Burdens)

There was a lot of concern about the costs of the Census of Production. After the First World War the Census was planned in detail for 1920 and then cancelled on cost grounds. It was announced again for 1922 and quickly shelved, and only finally reappeared for 1924. The 1924 Census covered businesses of all sizes, but thereafter there was a gradual change in the exemption limits which allowed the smallest businesses (eventually those with up to 10 employees) to provide only minimal information on employment and classification to be exempt from the main provisions of the Census. This reduced the costs (both to government and businesses) and thereby responded to criticisms of the need for such comprehensive data collection. Importantly, the consequent reduction in the number of questionnaires also reduced the time needed to process the Census.

Here is a second principle – once a survey has been put in place, usually with an up-front investment to facilitate development, there will very soon be retrenchment which aims to reduce costs, and this may continue for some considerable number of survey cycles until the quality becomes questionable or until there is some particular need for new data, when a further injection will be forthcoming. This leads to a cyclical pattern of investment which is clearly seen throughout the history of the Census of Production.

The next time the Census was reconsidered in detail was following the Second World War. Two reviews were commissioned immediately after the war, one to review the need for a Census of Production, and a second to consider a Census of Distribution (the UK had not at that time undertaken a Census of Distribution). The outcome of these two reviews was to reaffirm the need for statistics, and to provide the groundwork and impetus for the Statistics of Trade Act 1947, which widened the scope of what could be covered in the Census of Production, and at the same time enabled statutory collection of information from businesses for statistical purposes in other official surveys. One curiosity of the Statistics of Trade Act is that in making the Census of Production annual it *requires* the Census to be undertaken every year – the only survey required by UK legislation (other surveys, including the population census, are merely enabled by legislation).

2.3 Questions and notes (and burdens)

Many of the concessions around the passing of the Census of Production Act reduced the amount of detail which could be asked statutorily, and the first censuses focused on statistics of output and employment. There were very few questions on inputs, with purchases able to be collected only as a single aggregate, and no information on wages to be collected at all. (There was a continuing need for wages information, however, and a Census of Wages was run on a voluntary basis in many of the years when the Census of Production was run.)

Special Advisory Committees were set up to devise a suitable questionnaire for each industrial classification, and these added further, voluntary questions on a range of topics. The use of these committees, with representatives from industry, was felt to be very important in addressing the concerns of respondents, and there was also a Census of Production Advisory Committee which discussed more general details of the conduct of the census.

There was considerable concern about the burden on respondents in completing the questionnaire, but in some ways further development was hamstrung by the legislation. For example, production was the main interest and the Act allowed it to be collected. Businesses, however, usually didn't record production but kept good records of sales (because of liabilities for tax). Sales could be adjusted to give production by subtracting change in inventories ("stocks"), but the Census of Production Act did not allow the collection of inventories information. So a commodity breakdown of production was regularly sought which in theory involved businesses in making their own detailed calculations of sales less change in inventories, by commodity. At a time when all record keeping was paper based, there is likely to have been a substantial measurement error associated with this procedure; sadly there is no evidence for how well such questions were completed.

After the Statistics of Trade Act 1947 opened up collection to cover a wider range of variables (and made it more flexible by having a Schedule which could be updated to cover new variables by the easier process of laying an order before Parliament), the basis for collection was changed to sales and an aggregate figure for

inventories. The calculations to derive production then moved to the Census Office, which had more control over what was actually done, and the burden for the businesses eased. Although the need to estimate a commodity breakdown would normally mean that the quality would be poorer, we suspect that having a consistent method gave better quality than relying on businesses to make the correct adjustments.

3. Annual Censuses

3.1 Sampling (and Burdens)

Once the Census of Production began its annual cycle from 1948, with a large-scale survey including the smaller businesses, there was quickly pressure to save money. After the work of Neyman (1934), the obvious approach was through sampling, and although there had been some internal discussions in 1946 on whether random sampling methods could be used for official statistics, it was only introduced on the Census of Production in 1952. This reduced the burden further since substantially fewer questionnaires were issued, but also introduced a number of complexities.

First among these was the need for a sampling frame, with reasonable information on the size of businesses. Before the second world war, each Census had needed its own frame, constructed from a number of administrative sources specified in a schedule to the Census of Production Act. After 1948, the register was developed from the responses to the Census of two years ago (the most recent available at the time it was required), supplemented by administrative information on new businesses, and in some cases on those which had changed classification since the last available Census. Both new businesses and businesses changing classification were sampled much more heavily than stable businesses (in fact completely enumerated in most industries); this type of stratification is an idea which is being revived in business surveys in ONS, as there is potential for it to improve accuracy in some surveys.

Second, the sample had to be designed to meet the objectives. The detailed workings-out of the design do not seem to have been preserved, but the basic structure, of a design stratified by industrial classification and size (measured by employment), with reducing sampling fractions with reducing employment size, is one that is still very widely used in the UK.

Third, a method of estimation was needed to ensure that estimates for the whole business population could be published. Results from early censuses had been based only on the responding units, with at best some supplementary tables which gave an impression on one or a very few variables what proportion of activity might have been missed through non-response. With sampling a

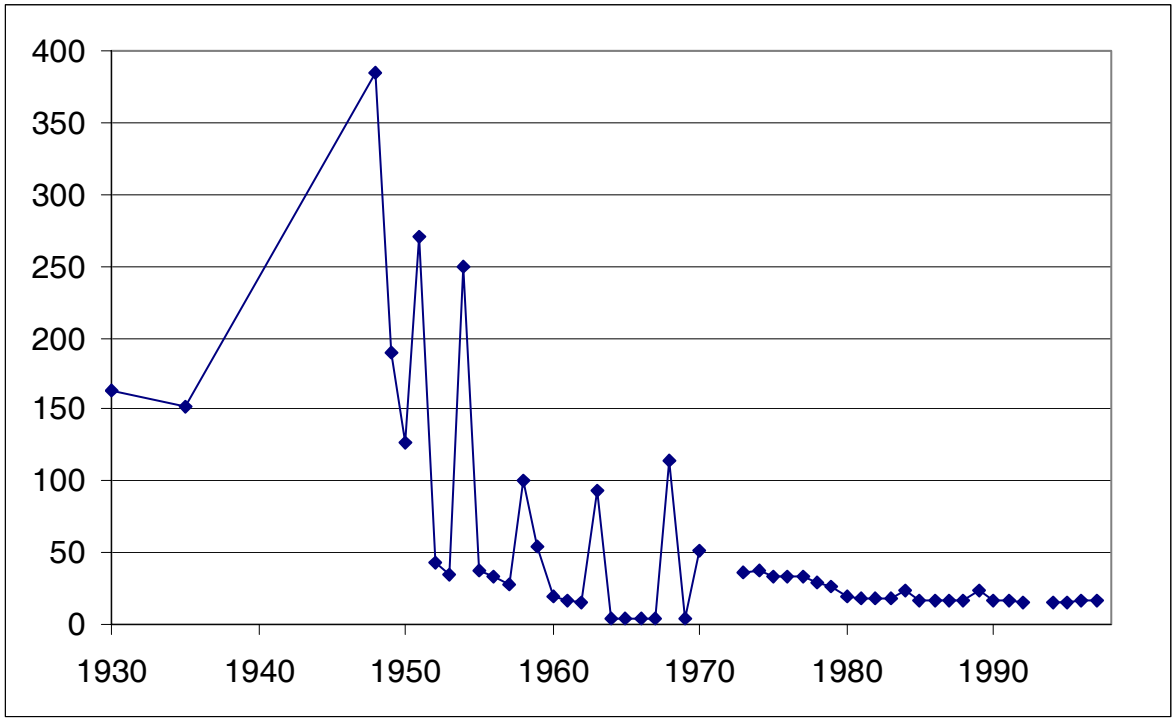

Fig. 1: Sample sizes (thousands) of the Census of Production and its equivalents from 1930 to 1997.

more systematic approach was needed, and initially the Horvitz-Thompson estimator was used (possibly because the first frame was based on a "slimline" census with reduced coverage of small businesses, and was therefore not very comprehensive). This was rapidly changed in 1953 to the ratio estimator, which has been the main estimator used in business surveys in the UK ever since.

It is interesting to examine the sample sizes of the Census of production from 1930, and these are shown in Fig 1. The pattern of occasional larger surveys with intervening smaller ones is clearly visible, as is the sample reduction from the full censuses to sampling from 1952. There is also a declining trend in the sample size towards an asymptote, which suggests that any further reductions will be at best marginal, as new methods are developed with slightly improved properties.

3.2 Coherence

After 1952 the same conditions prevailed on the Census of Production for around 20 years, with five-yearly detailed surveys covering more of the smaller businesses and collecting more detailed breakdowns, and intervening years collecting reduced breakdowns with reduced coverage. The Census was very useful as a benchmark for short-period surveys, which led to some consistency between different measures of output, but the range of official business surveys had still generally been developed piecemeal, which meant that there were inconsistencies in definitions and approaches.

The Estimates Committee, convened in the mid-1960s to examine the whole structure of British official statistics, recognised the basic lack of integration among the various surveys run by assorted government departments, and made recommendations aimed at putting a more coherent structure in place. The Census of Production was made stronger (after several years in the 1960s when it had very small sample sizes and collected only inventories and capital expenditure information), starting from 1970, with substantial detail each year. It was supplemented by Quarterly Commodity Inquiries, which collected a product breakdown of sales (and therefore the product breakdown was not required from the Census). Alongside these two surveys was a proposal for an integrated business register which could be used across government and provide a basis for consistency of statistical estimates.

There were pressures for integration in other areas soon afterwards. In the first half of the twentieth century, comparison of UK production with America and the Commonwealth countries was the main international driver, but in 1973 the UK joined the European Economic Community (EEC, now the European Union), and this moved the focus. There was already an EEC directive on annual production statistics, and the Census of Production needed only slight amendment to be in line with this. Later developments in Europe led to the adoption of harmonised classifications (from 1992 the UK Classification was harmonised with the European one), and in 1997 the Structural Business Statistics Regulation, which set out binding requirements for annual business data. In order to implement the regulation in the UK, it was decided to amalgamate the Census of Production with the other main annual surveys (covering employment across the economy, and the output of the services sector), to form the Annual Business Inquiry, and to introduce new methods through this new survey. The Structural Business Statistics Regulation introduced a certain amount of coherence and comparability across Europe, although substantial differences remained because of the different histories of the surveys in different Member States.

Over the same period, there were pressures for internal harmonisation too. The integrated register had not proved as easy to construct as originally anticipated by the Estimates Committee, but good progress was made in constructing a register from Value Added Tax (VAT) administrative data, for use in the services sector. Eventually in 1992 an integrated register did appear, combining administrative data from VAT and Pay-As-You-Earn income tax registrations (Perry 1995). This gave consistent coverage of the whole economy for the first time, and was one of the main facilitators which allowed the introduction of the Annual Business Inquiry, which merged collections in the production and services sectors.

The introduction of the ABI had a big influence on the business register, because the information on sites (local units) was originally collected from a separate Census of Employment. Once that was integrated with the new Annual Business Inquiry, there was still a need for local unit information for the register, which necessitated the introduction of a survey specially to gather business structures, the Business Register Survey. A further round of rationalisation is now seeking to integrate this with annual collection of employment information – almost a circle in the way different parts of the annual collections have been joined together, although at the same time there has been a lot of development along other axes, each enabled by the steps round that circle, and which could probably not have been achieved directly.

3.3 Consistency of Series

Over a century of a survey, there are very many things which have changed which make comparisons very difficult. Not least the whole economic context is different. Employment is one of the easiest, because

people are well-defined, although the industrial classification system into which employment is broken down has not been so stable.

The challenges in making such consistent series are discussed in BSO (1978) and Mitchell (1988); they normally involve making estimates of parts of totals and making suitable adjustments to add or remove these in series. In some cases this process will introduce substantial errors, and it may in some cases be unclear whether the adjustment has actually made the series better, because of the errors in the adjustments. Nevertheless the attempts to provide historically consistent data are useful in monitoring long-term trends in the economy, and can also show how economic development and statistical development have gone together – for example the progressive increase in statistical coverage of the services sector as services have become a more important part of the economy.

4. Recent and future developments

4.1 Technology

Technology has had a profound effect on the way in which Censuses are conducted and processed. Even such a simple task as contacting contributors has developed from post to telephone, then telex, fax and e-mail. The development of computer processing has revolutionized the speed with which results can be produced. At the same time, however, the methodological developments have also introduced more complex processes which need the new levels of computer power, and the user requirements for ever more detail also require additional processing.

Although there have been some big improvements in timeliness of parts of the processing, and the release of the Census of Production data has been speeded up, there is surprisingly little that can be done in some areas – particularly getting the questionnaires back from respondents – and this has meant that the requirements and the technology have largely kept pace with each other. This leads us to a further principle, which is that users will always push for additional information if the technology permits it, such that there is generally an equilibrium between what is possible and what is required with only small changes in timeliness and other quality measures.

4.2 Yet more integration

Integration continues to set the direction for developments in surveys generally in the ONS, and this remains true for the Census of Production (Annual Business Inquiry). The most recent focus is on getting a small set of methods and processes which can be applied consistently across a wide range of surveys, with the aim of reducing development and maintenance costs (particularly for computer systems, although there are benefits in other areas too). The general complexity of the information in the Census makes it both a good and a bad example for this – the potential for gains is quite large, but the systems need to cope with the complexity which means that they are not so easy to build.

The ONS is currently focusing on integration of its annual employment collection with the survey which updates local details on its register. There are plans for this to be followed later by a new Annual Business Survey, which will further integrate the annual structural collections. It is also hoped eventually to be able to introduce a "business omnibus survey" which will enable one-off questions to be easily included in these surveys. However, there are insufficient funds for these developments to proceed, and they remain a strategic aim.

5. Discussion

From examining the development of the Census of production in the UK we have been able to identify some general principles, about

- the difficulties in getting statistical legislation
- making maximum use of legislation that has been passed
- controlling the costs and burdens of surveys and the cyclical pattern of investment and retrenchment
- the continual drive for integration and consistency
- development and use of faster technologies gives an equilibrium of timeliness through the addition of extra requirements from both the methodology and the users.

These principles can be used to speculate on what will happen in the future. The trends for integration and consistency will continue, and indeed current plans have this as their main target. Other areas of consistency will also evolve – particularly international consistency for dealing with multi-national businesses. Developments in methodology and pressures on costs will interact to reduce sample sizes, but from Fig. 1 it is clear that the changes will generally be small. The range of outputs and analyses will extend as new methods bring their quality within acceptable limits – small area estimates are a particular example. But inevitably if detailed policies are to be developed to support business, the pressure for good information to develop and evaluate those policies will lead to an extension in data collection and the size of the survey in the longer term.

There is some cyclicality in the survey too. Ideas that have been tried before but not introduced, or used for a while and then dropped, can often be worth reconsidering, because in different contexts they may provide the basis of a very sound solution. Similarly, the way in which topics have been divided amongst surveys has changed – with employment split out, merged and now ready to be split out again. But each of these changes supports other developments, so the oscillation is only a by-product of different directions of development.

5.1 Conclusion

The research of the history and development of the Census of Production in the UK has clarified several aspects of local practice in the ONS, and generated ideas for approaches worthy of a second look. The general principles we have identified should be useful in understanding many surveys, but we encourage readers both to look at the evolution of their own surveys, and to document the developments you make yourselves so that they can contribute to the build-up of knowledge for later use.

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