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Ian Gazeley
University of Sussex

Rose Holmes
University of Sussex

Andrew Newell
University of Sussex and IZA

Kevin Reynolds
University of Sussex

Hector Gutierrez Rufrancos
University of Stirling.

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IZA – Institute of Labor Economics

Schaumburg-Lippe-Straße 5–9
53113 Bonn, Germany

Phone: +49-228-3894-0
Email: publications@iza.org

www.iza.org

ABSTRACT

Inequality among European Working Households, 1890-1960*

In this article we map, for the first time, the time-path of the size distribution of income among working class households in Western Europe, 1890-1960. To do this we exploit data extracted from a large number of newly digitised household expenditure surveys. Many are not representative of the population, or even of their target-subpopulation, as methods of social investigation were initially primitive, though rapidly evolving over this period. We overcome the consequent problem of comparability by exploiting our knowledge of the methods used by early social investigators to estimate of the scale of known biases. For some we have the original household data, but in most cases we have tables by income group. One by-product of this work is an evaluation of the range of estimation methods for distributional statistics from these historical tables of grouped data. Our central finding is that inequality among working households does not follow the general downward trend in inequality for the early part of the century found in labour share and top income studies. Contrary to Kuznets' prediction, our evidence suggests that on average income inequality among European working households remained stable for three generations from the late nineteenth century onwards.

JEL Classification: N33, N34, O15
Keywords: inequality, working households, Europe, 20th century

Corresponding author:
Andrew Newell
Department of Economics
University of Sussex
Brighton, BN1 9SL
United Kingdom
E-mail: a.t.newell@sussex.ac.uk

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Introduction

This article is an attempt to estimate the paths of the size distribution of income among working households across Western Europe, 1890-1960. The history of income inequality might seem to be settled, as there exists a wealth of previous work on this topic, see for instance Morrisson (2000), Williamson (1985, 1999), and the work of the top incomes group presented at The World Wealth and Income Database (WID.world). Indeed, Lindert (2000:12) argued persuasively that it might be advisable to move away from trying to establish trends:

> ...simply asking whether or not a country follows the famous inverted-U slows us down, by delaying our search for the more interesting interplay of underlying forces that give us a rich history of episodic movements, not just a long up-and-down movement. Given the opportunity to explore the changing effects of government policies, laws, wars, demography, technology and other forces on inequality movements from one episode to another, why settle for a debate over a single curve?

So, why do we seek further evidence? It is the first, necessary step for us to follow Lindert's suggestion of moving on to the analysis of change. We bring new data, having collected and digitised data and statistics from around one hundred and forty northern European household expenditure surveys. Household expenditure surveys form the major data resource for the contemporary study of inequality, but very little of the existing historical literature is based on such data. Instead, most historical studies rely on tax data, as well as piecing together evidence from key historical time series such as average wages by skill and labour's share in national income.

Inferences about the path of inequality from tax data, as Morrisson (2000) make abundantly clear, suffer from the vagaries of tax reform, especially in a period that saw the rolling out of more-or-less universal income taxation. Similarly, inferences about inequality made in studies based on wage or sectoral relativities tend to rely on assumptions on the size and direction of movement of within-skill-group inequality. Neither tax data nor pay relativities can help unpack how changes in income sources influence, and are influenced by, household formation and the allocation of paid work within the household. This is especially important for the study of inequality in Europe during the first half of the twentieth century, because average household size was smaller by mid century than it had been in the late nineteeth century, though the magnitude of this decline could vary by country, region, socio-economic

class, religious affiliation and ethnicity. By contrast, individual household survey data offer the chance to observe these changes and their impacts on inequality, which is why they are the preferred data source for modern measures of inequality.

Of course, inference on inequality from historical household expenditure surveys is not without problems. One well-known reservation about using household expenditure data sets is that many are not representative of the population, or even of their target-subpopulation, as methods of social investigation were initially primitive, though rapidly evolving over this period. We tackle the issue in two ways: first, our archival work expands considerably upon the volume of digitised datasets, which inevitably helps to alleviate the representativeness problem. We also confront the problem head-on by exploiting our knowledge of the methods used by early social investigators to estimate of the direction and scale of methodological biases.

The analysis of tax data has established (see WID.world) a clear picture of declining top incomes in many countries across the half of the 20th century, but trends in lower parts of the income distribution over this period are not yet established. There is plenty of evidence of improving living standards in Western countries, but we know little detail about how the relative incomes of poorer households fared and what the key drivers of change were. There is a long list of potential influences, including: technological change that may have shifted the demand for labour across the skill spectrum and changed the nature of unpaid domestic work; improvements in education; improvements in the social safety net; the demographic transition that resulted in fewer mouths to feed per household and allowed adult women to choose market work for more years in their lifetime; and greater trade union organisation of less-skilled workers.

At present, there is very limited statistical coverage of household inequality prior to the Second World War. For national inequality measures, there are four main international collections. The largest is the World Income Inequality Database (WIID) for the World Institute for Development Economics Research (WIDER). This gives, at the time of writing, over 8,800 Gini coefficients, as well as other inequality indicators, from around the world, and dating back as far as 1867. But only 10 Gini coefficients in the set are for West European countries prior to 1940 and only 24 prior to 1950. After that, coverage picks up but still there are only 59 for West European countries prior to 1960. Therefore, this database is not extensive enough to analyse changes in distribution within West European countries

before 1950. None of the other collections, from the OECD, the Luxembourg Income Study and the World Bank's Povcal.Net, give measures earlier than 1980. An exception is the OECD study by Sawyer (1976), which offers Gini coefficients for some West European countries for the late 1960s and early 1970s.

Our aim here is to contribute to the filling of these gaps in our understanding of an important period in world economic development: rapid technological change was driving sustained increases in per capita incomes in Western Europe, but progress was also riven by two global conflict and an intense depression. The structure of the paper is as follows. In the next section, we briefly place our research in the context of existing estimates on inequality for Western Europe, though this is not intended to be an exhaustive literature review and concentrates on evidence relating to the bottom end of the distribution in our period. Section 3 contains a discussion of the evolution of household expenditure surveys over this period, in respect of their methods and purpose. In section 4, we evaluate, with illustrations, the various ways the distribution of income/expenditure between households and people can be measured. After that, we discuss our methods of estimating inequality from grouped data, referring the reader to a working paper for detail, and offer some illustrative results. Finally, we study how our estimates vary systematically, depending on the nature of the underlying data, on the method of estimation, and other features of the data. This allows us to answer our research question: is there a significant Pan-European trend in inequality among working households over the early part of the twentieth century? Perhaps, surprisingly, we do not find one.

2. Our approach in context

The starting point for the literature on trends in economic inequality is Kuznets' (1955) seminal work that posited an inverted U-shape pattern in the time path of inequality. For Kuznets, inequality rose during early phases of industrialisation before falling as the economy matured. Kuznets' work influenced a generation of scholars who sought to investigate the empirical basis for his hypothesis. Where household income/expenditure data are unavailable, researchers have developed ways of estimating inequality from data that are available. Since the Theil index of income inequality is decomposable into income inequality between and within incomes from different sources, one approach is to add up these

components (see Morrisson, *op. cit*, p219). Key indices in this approach are: the share of labour in national income, earnings/wage differentials by skill, and tax revenue data.

Acemoglu and Robinson (2002), summarising the key cross-country studies of Williamson (1985) and Morrisson (2000), state that income inequality, as measured by the Gini, rose in the latter part of the 19th century and then fell through the early decades of the 20th century in the UK, France, Germany and Sweden. However, in the Netherlands and Norway, inequality fell continuously from the mid-nineteenth century onwards. Williamson (1985) argues that the available historical data for the nineteenth and first three-quarters of the twentieth century in the UK, USA, Sweden, Denmark, Netherlands, West Germany and Prussia, conforms to the downside of the Kuznets curve (see also Williamson 1991:58-59). Overall, the evidence for the rise in inequality during the initial phase of industrialisation - which is fairly robust for the UK and USA (see Lindert, 2000) and more tentative for nineteenth century France (Morrisson and Snyder, 2000) - is less widespread than the evidence for declining inequality during later phases of economic development, until around 1980, at least.

Most studies that have assessed changes in the functional distribution of income over time, find the share of wages in national income increasing fairly continuously over the first part of the 20th century (Kaelble and Thomas, 1991:35). However, most of these economy-wide estimates begin in the interwar period or later. For the nineteenth and early twentieth centuries Phelps, Brown and Browne (1968) calculated wage/income ratios 1860-1960 for the UK, USA, France, Germany and Sweden, defined as the average industrial wage relative to industrial income per occupied person, as a means of approximating 'the division of net pay between pay and profit' in the industrial sector of the economy (1968: 60-61). Dividing the century from 1860 to 1960 into three periods (before 1913, interwar and post 1950), they found: increasing wage/income ratios in each period for the UK; increasing during the interwar period and then remaining roughly stable for the USA; increasing only in the post-war period for Germany; and fairly flat across all three periods for Sweden (1968: 365 Table 32). They were not able to estimate wage/income ratios for all periods for France, though for the four other countries the wage to income ratio remained around 0.6-0.7 until after the Second World War (1968: 336).

Analysis of income inequality in the lower half of the distribution has also concentrated on the behaviour of pay ratios of male adult unskilled to skilled workers. According to Williamson (1991:62), economy-wide pay ratios for the UK increased during the first half of

the nineteenth century, reaching a peak in 1851, before falling back continuously thereafter to 1911. Horrell and Humphries (1992:863) using household expenditure survey evidence confirm this rise in the early 19th century 1787-1865. They find that the increase in adult male earnings inequality by skill is also reflected in a rise in household income inequality. From about 1914 there is a well-documented decline skilled wage premia among manual workers, see, for instance Gazeley *et. al.* (2017).

For Germany, Dumke (1991:131-2) finds falling pay ratios during the late nineteenth century to the turn of the century, rising again to 1914, then falling through WW1 and the Weimar period, before a short-term rise through the Nazi era, followed by substantial falls in the 1950s (1991:128 Fig. 5.1 (b)). In Sweden, Solderberg (1991:82-3) argues that adult male skilled/unskilled daily pay ratios for Stockholm follow a similar pattern as the one identified by Williamson for the UK, with a peak around 1840-5. However, economy-wide data that take into account composition effects show rising inequality 1870-1914, followed by strong levelling across the First World War until 1920. Inequality measured in this way, then widens again during the deflation of the 1920s and across the Great Depression, before a sustained and dramatic levelling from the early 1930s onwards, which continues through the Second World War to 1950 and after.

Narrowing nineteenth century wage differentials are also found in Belgium by Scholliers (1991) between the wage censuses of 1846 and 1896. However, it is noteworthy that Scholliers is also able to compare estimates of adult male pay inequality with near contemporaneous estimates of inequality from Belgian household expenditure surveys. He shows that inequality among households was considerably less than inequality among adult male wage earners at both dates, but especially so in 1896. He notes that at mid-century there were:

> …different kinds of subsistence strategies in families where the breadwinner earned a low wage. Female and child labour, small scale shopkeeping, taking in lodgers and so on were all means by which the family income was increased. This 'topping up' income led to a slight decrease in inequality in terms of family income. This is illustrated by the figures for Ghent working class family incomes in 1853…… Total family incomes were 75 per cent higher than those of the head of the family in a low wage category and 52 per cent higher in the high wage category. The pay differential between the respective breadwinners amounted to nearly 100 per cent, whereas family income differentials amounted to 'only' 70 per cent (1991: 103-4).

By 1896, the practice of 'topping up' low wage head of households' income from other sources had a greater effect on measured household inequality, reducing differences in household incomes by skill of principal wage earner to 'virtual insignificance' (1991:111-2). This is an important result in the context of our research, as it suggests that the evidence of generally falling West European pay ratios between the late nineteenth century and mid-twentieth century, may not be as evident in household-based measures of inequality.

The most influential set of studies of the last fifteen years or so exploit tax revenue data to estimate the income shares of top income groups. It is well known that regular survey methods are not good at collecting information from very wealthy individuals, so the addition of long-run trends in these shares offers much new information. This has been the work of a group, led by, among others, Facundo Alvaredo, Anthony Atkinson, Thomas Piketty and Emmanuel Saez. The results, and reference for the research papers on which they are based, are collected together in The World Wealth and Income Database (WID.world). This database contains trends in top income shares for many European countries. In brief, for the first half of the 20th century they report declines in the top income shares in Denmark, Finland, Norway and Sweden. Similarly they report declines in top income shares over the same period in France, Germany (to 1939) the Netherlands and the United Kingdom. Tax data are not yet available for Italy, Spain and Portugal, so knowledge of South Western Europe remain mostly out of reach. Below we discuss the relationships between our findings and the results of the top incomes work.

Lastly, Rossi *et. al* (2001) is an ambitious attempt to build a household survey-based statistical picture of the path of inequality in Italy 1881-1961. Their research takes a very different approach to that adopted here, which is described below in detail. Briefly, our approach is to estimate household-level inequality within the existing surveys. The surveys, with a range of different objectives, ask different sets of questions, so that, for instance, we know little about the people in the household in some surveys, or we only have income data, or expenditure data in other surveys. Surveys where there is insufficient information to estimate any form of inequality are not considered, and cases within surveys with insufficient information are dropped. We estimate measures of inequality, made on a variety of bases, and then, later, gather these into a data set that also contains indicator variables for the various aspects of the surveys (time, place, target population, the use of income vs.

expenditure etc.). This allows us to control for the impacts of differences in the surveys on measures of inequality.

By contrast, Rossi *et. al.* (2001) set themselves the task of creating a data set that is as close to what is known of a population as possible. They use existing budgets to create a target survey structure, to which only a subset of existing surveys or budget observations, can be made to conform. In cases where information is incomplete, they employ a hot-decking procedure to use observations (households) where data exist to 'donate' information to observations where data do not exist, thereby creating a set of synthetic observations (2001, p. 909). Subsequently, they make adjustments for population representativeness. In summary, the approach of Rossi *et. al.* is to try to augment the existing fragments of data and, finally, to create a synthetic population. The approach taken in this paper, by contrast, eschews the creation of synthetic data and relies on regularities between results from sources of similar types to allow inference about longer-term movements.

3. The Evolution of Household Budget Surveys in Western Europe, 1850s-1950s

Household budget surveys seem to have been a West European innovation, and their evolution is implicitly involved with the emergence of particular conceptions of West European nation-statehood and citizenship. We see, between the 1850s and 1950s, a four-stage shift in the methodology and focus of domestic household budget surveys, though each stage is not necessarily temporally unique or self-contained. The Western European nations involved in colonial expansion developed separate techniques for analyzing the domestic structure of the family lives of citizens of overseas territories, which we do not consider here (see Gazeley and Holmes 2018 for a fuller description).

The first modern attempts to collect and analyse household budgets that we are aware of are due to David Davies (*The Case of Labourers in Husbandry*, 1795) and Fredrick Eden (*The State of the Poor* 1797). Eden and Davies collected household budgets of income and expenditure from the rural labouring poor in the late eighteenth century for the explicit purpose of providing empirical data to inform contemporary debate on the cost of poor relief and reform of the poor laws (Gazeley and Verdon, 2014). According to Stigler (1954) two developments led to a revival of interest in budget studies from the mid-nineteenth century onwards: the wave of unrest that swept Europe culminating in the revolutions of 1848 and

developments in statistical theory that permitted a more sophisticated analysis of social data (1954:96). Household budget surveys in the latter half of the nineteenth century were mostly carried out from a sociological perspective, either by social reformers or academics tending to follow the LePlay/Ducpétiaux model of detailed social analysis of households alongside a breakdown of income, expenditure, food consumption and nutrition.[1] International collaborative endeavour between researchers began to shape a shared methodology for conducting surveys in a series of nine meetings of the International Statistical Congress (ISC) held between 1853 and 1879 (Randeraand, 2011). The Belgian statistician Adolphe Quételet and other European statisticians were, during this period, increasingly turning their attention to the use of statistics to measure human growth and development (Eknoyan, 2007). Household budget surveys also provided data that allowed the formulation of statistical regularities such as Engel's Law. While the ISC meetings helped formulate international statistical knowledge-sharing, Randeraand (2011) argues that their main function was to contribute towards the acceptance of statistics as a fundamental guide in the political decision-making of nation-states.

The second stage of development focussed on collecting comparative international data, primarily to evaluate the impact of tariffs and trade. In the Unites States, the Commissioner of Labor, Carroll D. Wright, conducted an extensive survey of household income and expenditure in the US and five West European countries in 1889/90, motivated by the McKinley Tariff question (Williamson, 1967). Before the turn of the twentieth century, West European governments also began to see household budget research as part of international trade and labour research. From the 1890s, departments of international labour began to undertake research employing methodologies adapted from those used by social investigators and academics. In the first decades of the twentieth century, most European governments created statistical offices, and the responsibility for undertaking domestic household budget surveys shifted to state-employed statisticians. Perhaps the best example of this type of enquiry is the British Board of Trade's collection of household budgets (1908-1911), which investigated the cost of living in France, Germany, Belgium and the United States, for the purpose of comparison with the UK. The Board was influenced by Le Play's mid-nineteenth

[1] Key examples include: F. Le Play, Alfred Mame Tours et fils*, Ouvriers européens. Études sur les travaux, la vie domestique et la condition morale des populations ouvrières de l'Europe, précédée d'un exposé de la méthode d'observations par*, 2e éd., 1877-1879. 6 vol.; E. Ducpétiaux, Budgets economiques des classes ouvrieres en Belgique (1855); B.S.Rowntree, *Land and Labour: Lessons from Belgium* (London: MacMillan and Co., 1910); Ernst Engel, *Die LebenskostenBelgischer Arbeiter-Familien Früher und Jezst* (Dresden: C.Heinrich, 1895 [1857]).

century investigation of working-class living conditions in Europe, and the later investigations of Belgian household budgets by Ducpétiaux as well as the German budgets conducted by Gruber. From their inception, government-instigated household expenditure enquiries in the UK were motivated by two objectives: the desire to calculate a cost of living index and the comparative analysis of living conditions among industrial competitors.

We see a third stage beginning after the First World War, as European and non-European governments, guided by the League of Nations, became increasingly invested in developing shared methodologies of budgetary surveys – primarily for the purpose of constructing cost of living indices. Held under the auspices of the International Labour Organisation (ILO), the 1926 International Conference of Labour Statisticians was attended by representatives from almost every European nation and several non-European nations. They agreed that household budget surveys were the best way of assessing living standards, and adopted a clear, shared methodological framework that if possible, countries would use in their investigations (International Labour Organisation, 1926). It also, for the first time, agreed on a timescale with countries that had not undertaken an enquiry since 1920/21, resolving to launch major surveys using the new methodological approach before 1928. In the same (interwar) period, however, it is worth noting that some prominent researchers, notably Carle Zimmerman (1936: 378-415), felt that something had been lost in the move towards internationalism, and that regular, local, small-scale representative studies taken very much in context were the best way to ensure accurate reporting.

The final stage is best seen as driven by a desire to implement developments in statistical methodology to improve the representativeness of samples in relation to their target populations. In 1949, the ILO again prioritised household budget surveys and distributed new methodological guidelines to member states, emphasising the importance of random sampling, accurate record-keeping and international uniformity (International Labour Organisation 1949). Having previously focused chiefly on urban, working-class nuclear family households, survey-takers now employed random sampling techniques to attempt representative population analysis. In the late 1940s and 1950s, surveys thus became more comprehensive, partly due to the continued international co-operation between the statistical branches of European governments, and partly due to the new interventions of the UN, which emphasised household budget research on a global scale (Darmois *et al*, 1949).

Household budget surveys emerged as a way for social reformers to demonstrate the condition of the poor and, by implication, to influence contemporary debate on social policy. In the nineteenth century, they were the petri dish of statistical methodology. By the turn of the twentieth century, they were an accepted apparatus in both the domestic economy and foreign policy decision-making process of nation-states. And by the mid-twentieth century they allowed NGOs to hold nation-states to account for the comparative household economies of their citizens. Always products of their time, they demonstrate the emergent power of crisis-born institutions and the move away from nineteenth century forms of nationalism towards a globalised economy. Prais and Houthakker (1971) argue that the value of household budget studies is to comment on the condition of the people, derive weights for cost of living indices and for empirical studies of consumption behaviour (1971:4). We would add to this list their value to the investigation of inequality among the working class families surveyed.

This study exploits the set of European household expenditure surveys collected by the Global Income Inequality Project[2]. Although we have recovered and analysed individual level data from around forty household surveys in this period, the majority of the items in the collection are tables from survey reports, rather than individual-level data. These tables present averages from the surveys grouped by household income. They contain the number of households in each group, as well as, variously and among other things, averages of: income, expenditures on main items and numbers of children. Table 1 presents the coverage of our findings, by country and decade. The total number of surveys found by the project is much larger, but here we count only those that provide useable data or statistics. There are, for instance, eighty-one surveys that are usable for the estimation of inequality for the pre-1940 period. This is a major advance on WIDER's WIID database.

<Insert Table 1 here>

4. Estimating inequality from household expenditure surveys

There are three main challenges in this regard. First there is the choice of unit of measurement: income, expenditure, per household, *per capita* etc. Where we have individual household-level data, the surveys vary in the range of questions asked of respondents but

[2] Funded by ESRC grant Global Income Inequality 1880-1960, grant no. ES/L002523/1

usually several possibilities exist. Where we have grouped tables, the unit of measurement of the group is what we have to use, most commonly, total household income. Thus, limitations to the available information on household composition affects our choice of the key unit of measurement. Second, there is a set of issues surrounding the creation of parameter estimates from income-grouped tables. Third, for estimates derived from either grouped tables or individual-level data, there is the question of population representativeness of the samples, and the possible adjustments that can be made. Here we take a regression approach by treating the sampling characteristics of a survey as explanatory variables in regression seeking to explain differences between survey inequality measures. This is further discussed in Section 6 below. Here we discuss the first two challenges.

4.1. The choice of unit of measurement

There are a number of ways of calculating economic welfare among members of a household. We divide our discussion into three parts: the choice of numerator, the choice of denominator and whether we estimate inequality between households unweighted or weighted by family size. For the numerator, our surveys will typically offer us at least one of the following over the relevant period of observation: total household food expenditure, total household expenditure, or total household income. We find quite similar results where we can compare inequality estimates using either total expenditure or total income. Initially, this was surprising given that saving behaviour and commonly observed inconsistencies in responses to income and expenditure questions were likely to cause differences. This might come about because of the imperfections of recall while attempting to record expenditures and incomes as part of completing the questionnaires. Here we present, as a first step, estimates derived from all three measures.

The choice of the denominator, however, has a profound impact on our results. The contemporary standard method is to divide income or expenditure by the number of equivalised people, using an equivalence scale, such as the OECD Modified Scale.[3] This requires knowledge of the numbers of people of different ages or, at a minimum, the numbers of adults and of children in the household. Where we have individual household data this information is often available. Where we have grouped data, this is problematic (see section 3 below). With individual household-level data we can employ Stephen Jenkins' (1999)

[3] http://www.oecd.org/eco/growth/OECD-Note-EquivalenceScales.pdf

Stata suite of distributional statistics, for instance *sumdist* and *ineqdeco*. These give a wide range of inequality measures and have been used in scores of studies.

Lastly there is the issue of weighting by the number of people in the household. This is not always possible, but in cases where is can be done it makes sense to weight estimates of *per capita* income by the number of people, or estimates of incomes per equivalent adult by the number of equivalent adults.

4.2 Estimating inequality from grouped data

In most cases where we rely on grouped tables, households are grouped by total household income. There are cases where we have tables giving averages for households that are grouped by *per capita* or equivalised incomes or expenditures. For instance, many early Belgian and Norwegian studies present results grouped by equivalised incomes. For such cases there are various existing ways of estimating measures of inequality. Perhaps the simplest and certainly the best-known method is to employ Chen, Datt and Ravallion's Povcal[4] software which is designed to estimate poverty and inequality from grouped statistics via the estimation of General Quadratic and Beta Lorenz curves, originally formulated by Villasenor and Arnold (1984, 1989) and Kakwani (1980), respectively.

This approach, however, has its downside for our study, since the Gini coefficient is Povcal's sole distributional statistic and this is very restrictive in terms of inequality measurement. So instead, we programmed our own suite of methods. Gutierrez Rufrancos and Newell (2017) describes and tests these methods, which are also summarised in Appendix 2. Here we have chosen to illustrate our findings using two alternative methods of estimation. Firstly, the 'Groups Naïve Frequency Method', simply assigns the group mid-point to each household in the group and then calculates the Gini coefficient. Secondly, we estimate the parameters of Kakwani's Beta-Lorenz approach (Kakwani, 1980). It becomes clear through the tables of descriptives and regression analyses that the two methods give very similar results.

5. Inequality measures

[4] http://go.worldbank.org/YMRH2NT5V0

We constructed around 150 sets of inequality measures from our surveys (some surveys contained more than one sub-survey). Of these we obtain just over 130 that come with sufficient ancillary information for our estimation. Tables 2 and 3 give summaries of inequality measures estimated, in turn, by our naïve and Beta-Lorenz methods. The first thing to note is that since these data sets mostly contain information on working class households, measured inequality is generally much lower than it would be across the population. Secondly, note that the two tables give very similar information, except that while inequality as measured by Beta-Lorenz is around 10% higher than the naïve estimates, 90/10 and other decile ratios are lower when estimated by Beta-Lorenz. This comes about as the curvature in Beta-Lorenz assumes less density in the tails of the distributions than simple interpolation, but also swings lower though the centre of the distribution. Other facts that emerge are that *per capita* income tends to be less unequally distributed than household income. This is because, for many cases, household membership and household income co-vary positively.

<Insert Table 2 and 3>

Statistics derived from tables grouped by income tend to generate higher measured inequality, whereas tables grouped by characteristics other than income, such as occupation or household size, understandably, give much lower estimates. Post 1939 inequality is higher in these tables but this may be related some aspects of surveys that change over time, in particular, as discussed in section 3, sampling methods. Taking the surveys as a whole we see that those that followed stratified random sampling give much higher average levels of inequality. Of course there are other reasons, not tabled here, that would give rise to different levels of inequality. Firstly, sample sizes vary from scores to tens of thousands. Secondly, the target population varies across these surveys. For example: some are exclusively urban; others concentrate on manual workers' households only.

Table 4 studies one key conflation, for our purposes, by presenting mean Gini coefficients by era and by sampling method. Separating underlying trends in inequality from trends in sampling is the main objective of this study. The result is that post-1939 Ginis are only higher if they are known to derive from stratified random sampling. Other post-1939 Gini coefficients are not notable higher. This suggests the upward overall time trend in inequality in these statistics is likely to be a product of evolving sampling method. For the case of the UK, we have studied this issue in detail and confirm that there is no rise in inequality among

working households in this period once changes sampling methods and target population are taken into account, see Gazeley *et. al*. (2017).

6. Analysing the historical path of inequality among working households

In this section, we take estimated inequality measures and analyse the extent to which their variation over time and space is due to differences between countries, changes over time and differences in: sampling methods, target samples, and choice of groups. There is another potential source of variation: in Appendix 2 we describe how we tested six methods of estimating inequality from grouped tables. Early experiments showed us that the important results with respect to non-estimation issues were unaffected by the choice of estimation method. This results is foreshadowed by the similarities in relative inequality measures in Tables 2 and 3 where results were presented for, respectively, our 'naïve' and Beta-Lorenz estimation methods. Here again, to illustrate this without asking the reader to wade through too many tables, we present our key findings from regressions in which countries are pooled and the dependent variables are statistics estimated two different ways: by our 'naïve' and Beta-Lorenz methods, see Appendix 2 for a longer discussion.

In the pooled regressions given in Tables 5 and 6, the Gini coefficient, the 90/10 and 50/10 ratios are the dependent variables. The list of explanatory variables includes (unreported) country controls, and controls for the era in which the surveys were carried out. We choose break point years 1918 and 1939, though results are not sensitive to the exact choices of years to separate the interwar years from before and after.

In the first column of Table 6 the dependent variable is the Gini coefficient calculated, as discussed above, by our simple naïve method. We investigate how this varies with all the measured and recorded characteristics of the surveys by weighted least squares, with the weights being the square roots of the numbers of respondents in the surveys[5]. Taking the explanatory variables in turn, we find that including rural households in the survey generally

[5] This is a standard correction for heteroscedasticity in cases like ours, see a very useful recent discussion in Solon *et. al*., (2015).

raises the estimated Gini, as does the inclusion of urban households. The two coefficients are close in size, giving us the result that a survey that covers both rural and urban areas, rather than only one of these, will provide an estimated Gini, on average, between 8 and 9 points higher.

Next we control for cases where the survey tables are not simply delimited by income. From an income perspective these cases might create tables of overlapping income groups, and so one would expect a lowering of measured inequality if we treat them as non-overlapping. To be clear, if households were randomly assigned to groups, then there would be only random differences in group average income, so that estimated between group inequality would be negligibly small. But most of the groupings: region, social class, household size occupation, do indeed vary quite substantially with income. Here we find a strong negative effect reducing inequality, approximately eleven Gini points, if non-income groups are used. Another case is where we are given income groups, but by one or more separate characteristics additionally. In other words there is more than one group in the same income range. This should not have the effect of lowering Gini inequality, and we do not find a strong negative or positive effect on the Gini.

Next we control for cases where the survey tables have not given us the within-group mean income. Here we simply replace the mean with the group mid-point. This replacement could have different effects in different parts of the distribution, but the largest effects will be at the extremes, where the mid-point of a group would be further from the centre of the distribution than the mean and thus using it would bias a Gini upwards. The results support this with a substantial average rise of just under five Gini points. We also control for cases where only households headed by a manual worker are considered, but this gives us no notable results.

Another set of controls reflect the survey type: stratified random sample, snowball aiming at a particular group; snowball attempting to be representative; or unknown. The unknown are the omitted group. Perhaps surprisingly, none of these seem to generate significant average differences. These results should be taken together with results from the era variables, since we know that sampling methods were evolving. We turn to these next.

As Table 4 shows, if one compares mean Ginis by era *and* method of sampling the only group with a much higher mean is the group of Ginis from post-1939 stratified random samples. The other surveys in the period do not have a higher average Gini, and there were

very few surveys in our collection, just three, conducted by stratified random sampling prior to 1939. There were, however a larger number of non-stratified random samples among the post 1939 surveys. We test for this by including an interaction between the indicator for a post-1939 survey and one for a stratified random sample. Though this is not significant, the negative coefficients on the pre-1939 era variables are negligible and conventionally insignificant. Thus this regression confirms that the Table 4 result remains in place after many controls are added. The other columns for Table 5 show very similar results for the 90/10, 90/50 and 50/10 decile ratios. Across 40 different measure of inequality, we find no evidence of a region-wide trend in inequality among working households. Of course one might argue that the estimation method for the inequality measure might be so noisy around 'true' inequality that not much can be inferred, but we do find a number of sensible results in this table, on the geographical extent of the surveys, types of groups used and so on.

The point of the results in Table 6 is to repeat the analysis of Table 5 with Beta-Lorenz estimated inequality measures. Here the key results are closely in line with those of Table 5. Again we find no sign of a general downward trend in inequality. However here we find that interaction term that singles out post-1939 survey with a stratified random sampling design, is well determined and negative in two cases out of four (the 90/10 and 50/10 percentile ratios

<Insert Tables 5 and 6 here>

7. Conclusions: Inequality among working households 1890-1960

Any attempt to explain estimated variation in income inequality measures over time and space need to be able to identify the extent to which these are due to genuine differences between countries, or due to differences in sampling methods, target samples, and choice of groups. In this article we go some way towards resolving this conundrum. We have built up a database of household expenditure surveys for Western Europe 1890-1960 that extends the existing evidence base by about a factor of ten and charts the behaviour of inequality, for the bottom 4/5ths of the population (more at the end of the period). The results of the analysis of over 130 surveys warn very clearly of the pitfalls of inferring changes and other comparisons based upon inequality measures created with differing methodologies. On the other hand,

there are regular-looking patterns in measured inequality, for instance, the effects of: limiting regional coverage; differences in the grouping of cases and from the use of midpoints in place of group means.

The most notable outcome of this analysis is the lack of a definite long-term trend in these inequality measures. This is a surprising result because other indicators of inequality from the lower half of the distribution suggest a clear trend of declining inequality during the twentieth century for most West European countries. Our household-level results suggest that household inequality may not have followed the generally declining path of inequality on the downside of the Kuznets curve that tax, national accounts and relative wage data show.
Taking our results at face value, what might be the reasons for the different behaviour of household level inequality from the other series which seem to show declining inequality? It is possible to speculate that this divergence may well be due to a combination of factors, including: labour market participation decisions of the household and/or income " topping-up" by low wage households. It may be that these practices were more widespread and pervasive than is currently recognised in the existing scholarship on historic income inequality.

In more detailed work using the British survey data, Gazeley *et. al.* (2017) support the finding here of no evidence of declining inequality among working households in the first sixty years of the twentieth century. They find that this lack of movement was due to the offsetting effects of a variety of forces, some equalising and some tending to raise inequality. For some other European countries, it may also be possible to establish trends in inequality over time. But here, taking the evidence as a whole, it seems that for working households this was a broadly stable period in the European household income distribution.

References

Acemoglu, Daron, and Robinson, James, A., (2002) 'The Political Economy of the Kuznets Curve' *Review of Development Economics*, 6 (2), 183-203

Aitchison, J. and J. A. C. Brown (1963). *The Lognormal Distribution*. Number 5 in Department of Applied Economics Monograph. Cambridge: Cambridge University Press.

Alvaredo, F, (2011), A note on the relationship between top income shares and the Gini coefficient, *Economics Letters*, 110 (2011) 274–277

Atkinson, A.B., (2003) 'Income Inequality in OECD Countries: Data and Explanations' *CESifo Economic Studies*, 49(4) 479-513

Atkinson, A. B. and F. Bourguinon (2000), *Handbook of Income Inequality Volume 1*, North Holland, Amsterdam.

Atkinson, A. B., T. Piketty & E Saez, (2011), "Top Incomes in the Long Run of History," *Journal of Economic Literature*, American Economic Association, vol. 49(1), pages 3-71, March

Brenner, Y.S., Hartmut Kaelbe and Mark Thomas, (1991) *Income Distribution in Historical Perspective*, Cambridge, CUP.

Darmois, G., W.E. Deming, P.C. Mahalanbois, F. Yates, and R.A. Fisher (1949), *The Preparation of Sampling Survey Reports* (Statistical Office of the United Nations, New York).

Ducpétiaux, E. (1855). *Budgets Économiques des Classes Ovrières en Belgique. Subsistance, Salaires, Population*. Bruxelles: M. Hayez, Imp. De La Commission Centrale de Statistique.

Dumke, Rolf (1991) 'Income Inequality and industrialisation in Germany' in Brenner, Y.S., Hartmut Kaelbe and Mark Thomas, *Income Distribution in Historical Perspective*, Cambridge, CUP.

Gastwirth, J. L. and M. Glauberman (1976, May). The Interpolation of the Lorenz Curve and Gini index from Grouped Data. *Econometrica 44*(3), 479–483.

Gazeley, I and A Newell (2011) "The End of Destitution", *Oxford Economic Papers*, 64 (1), pp.80-102 doi: 10.1093/oep/gpr032.

Gazeley, I., A. Newell, and M. Hawkins (2015). Ministry of Labour & National Service Family Expenditure Household Survey 1953-54. Dataset, University of Sussex, Brighton.

Gazeley, I and Verdon, N (2014) 'The First Poverty Line? Davies' and Eden's investigation of rural poverty in late 18th-century England' *Explorations in Economic History*, 51, 94-108

Gazeley, Ian, Andrew T. Newell, Kevin Reynolds, Hector Gutierrez Gutierrez Rufrancos (2017) 'What Really Happened to British Inequality in the Early 20th Century? Evidence from National Household Expenditure Surveys 1890–1961 ' *IZA Discussion Paper* no. 11071, October.

Eknoyan, Garabed (2007) 'Adolphe Quetelet (1796-1874)-the average man and indices of obesity'. *Nephrology Dialysis Transplantation*. Volume 23, Issue 1. Pp. 47-51

Horrell, Sara and Humphries, Jane (1992) 'Old Questions, New Data, and Alternative Perspectives: Families' Living Standards in the Industrial Revolution' *Journal of Economic History*, Vol. 52, No. 4 (Dec., 1992), pp. 849-880

International Labour Office (1926), *The Third International Conference of Labour Statisticians.* Studies and Reports. Series N. No. 12.

International Labour Office (1949) *Methods of Family Living Studies.* Studies and Reports, New Series, No., 17.

Jenkins, S. P. (1999). INEQDECO: Stata module to calculate inequality indices with decomposition by subgroup. Statistical Software Components, Boston College Department of Economics.

Kuznets, Simon (1955) 'Economic Growth and Income Inequality' *American Economic Review*, 65, 1-28

Kakwani, N. (1980), On a Class of Poverty Measures, *Econometrica*, 48(2), 437–446.

Lerman, R. I. and S. Yitzhaki (1989). Improving the Accuracy of Estimates of Gini Coefficients. *Journal of Econometrics 42*(1), 43–47.

Lindert, Peter, H., (2000) When did inequality rise in Britain and America? *Journal of Income Distribution*, 9, 11-25

Morrisson, C, (2000) Historical Perspectives on Income Distribution: the Case of Europe, Chapter 4 in Atkinson, A. B. and Bourguinon F. (eds.), *Handbook of Income Inequality Volume 1*, North Holland, Amsterdam.

Morrisson, Christian and Synder, Wayne, (2000) 'The income inequality of France in historical perspective', *European Review of Economic History*, 4, 59-83

Prais, S.J., and Houthakker, H.S. (1971) *The Analysis of Family Budgets*, Cambridge, CUP.

Pyatt, G., C.-N. Chen, and J. Fei (1980). The distribution of income by factor components. *The Quarterly Journal of Economics 95*(3), 451–473.

Randeraad, Nico (2011) 'The International Statistical Congress (1853-1876): Knowledge Transfers and their Limits' *European History Quarterly* 41(1), pp. 50–65.

Rossi, N., G. Toniolo and G. Vecchi (2001), 'Is the Kuznets Curve Still Alive? Evidence from Italian Household Budgets, 1881-1961,' *Journal of Economic History*, 61, 4, 904-924.

Sawyer, M. (1976) "Income distribution in the OECD countries', *OECD Economic Outlook*, OECD, Paris.

Scholliers, Peter (1991) 'Industrial wage differentials in nineteenth century Belgium' Brenner, Y.S., Hartmut Kaelbe and Mark Thomas, *Income Distribution in Historical Perspective*, Cambridge, CUP.

Soderberg, Johan (1991) 'Wage differentials in Sweden' in Brenner, Y.S., Hartmut Kaelbe and Mark Thomas, *Income Distribution in Historical Perspective*, Cambridge, CUP.

Solon, Gary, Steven J. Haider, and Jeffrey M. Wooldridge (2015), 'What Are We Weighting For?', *Journal of Human Resources,* 50:301-316.

StataCorp (2015). *Stata Statistical Software: Release 14.* College Station, TX: StataCorp LP.

Stigler, George, J.,(1954) 'The Early History of Empirical Studies of Consumer Behaviour' *Journal of Political Economy*, Vol 62. No 2 (April), pp.95-113

Villasenor, J., and B. C. Arnold. 1984. The general quadratic Lorenz curve. Technical report, Colegio de Postgraduados, Mexico City. Photocopy

Villasenor, J., and B. C. Arnold (1989), Elliptical Lorenz Curves, *Journal of Econometrics* 40 (2): 327–338.

Williamson, Jeffrey, G. 'Consumer Behaviour in the Nineteenth Century: Carroll D.Wright's Massachussets Workers in 1875" *Explorations in Economic History* 4, No 2:98-138

Williamson, Jeffrey, G., (1985) *Did British Capitalism Breed Inequality*? Winchester Mass., Allen and Unwin.

Williamson, Jeffrey, G., (1991) ' British Inequality during the Industrial Revolution' in Brenner, Y.S., Hartmut Kaelbe and Mark Thomas, *Income Distribution in Historical Perspective,* Cambridge, CUP.

Zimmerman, Carle, C., (1936) *Consumption and Standards of Living* New York, D. Van Nostrand Company, inc., 1936

Table 1 Distribution of surveys used by country and time period

	Pre-1900	*1900-1919*	*1920-1939*	*1940-1949*	*1950-1960s*
Austria		1	2		
Belgium	4	2	1	1	
Denmark	1	1	3	2	1
Finland		1	3		3
France	1	4	1	5	4
Germany	2	8	5		1
Greece		1	1		8
Ireland	2				1
Netherlands		3	3		1
Norway		6	1	1	7
Poland			3		1
Sweden		4	5	4	3
Switzerland	1	2	6		
UK	1	1	1		2
Sum	12	34	35	13	30

Table 2: Average 'naïve' Gini coefficients and decile ratios, by survey characteristics

	N	Gini	90/10	90/50	50/10
Derived from data:					
Individual household level	42	0.234	3.16	1.76	1.76
Grouped by income/expenditure	55	0.229	4.04	1.86	2.00
Grouped by income and other aspects	42	0.223	3.64	1.74	2.01
Grouped by other aspects	15	0.112	2.13	1.27	1.62
Era					
Pre-1920	60	0.216	2.85	1.73	1.61
1920-1939	41	0.197	3.12	1.69	1.78
Post-1939	54	0.235	4.54	1.80	2.31
Survey Design					
Unknown	64	0.202	2.84	1.68	1.64
Non-random/non representative	34	0.213	3.02	1.67	1.78
Non-random/attempted representative	19	0.190	3.18	1.62	1.92
Stratified random sample	26	0.276	5.51	2.01	2.56

Sources and notes: see text

Table 3: Average Beta-Lorenz Gini coefficients and decile ratios, by survey characteristics

	N	Gini	90/10	90/50	50/10
Derived from data:					
Individual household level	42	0.236	3.00	1.71	1.69
Grouped by income/expenditure	55	0.259	3.15	1.62	1.80
Grouped by income and other aspects	42	0.230	3.47	1.68	1.88
Grouped by other aspects	15	0.124	1.80	1.28	1.39
Era					
Pre-1920	60	0.229	2.72	1.62	1.62
1920-1939	41	0.214	2.56	1.53	1.58
Post-1939	54	0.249	3.85	1.71	2.03
Survey Design					
Unknown	64	0.215	2.48	1.55	1.57
Non-random/non representative	34	0.222	2.77	1.60	1.70
Non-random/attempted representative	19	0.199	2.52	1.49	1.64
Stratified random sample	26	0.295	4.28	1.85	2.17

Sources and notes: see text

Table 4. European Gini coefficient averages by sampling method (%, with number of coefficients in brackets)

Sampling method	*Pre-1920*	*Interwar period*	*Post-1939*
Unknown	21.5 (35)	18.5 (23)	18.6 (6)

Snowball sample	20.6 (22)	23.7 (8)	20.4 (4)
Other non-random		23.0 (3)	18.2 (16)
Stratified random sampling		21.6 (3)	28.4 (23)

Table 5. Understanding the variations in European working household inequality 1890-1960

Naïve estimates of	Gini	90/10	90/50	50/10
Explanatory factors:				
Era: (default=post 1939)				
Before 1920	-0.011	-0.376	0.005	-0.174
1920-1939	-0.005	-0.252	-0.005	-0.093
Post 1939*Stratified Random	0.062	1.873	0.137	0.864*
Survey design				
Rural households included	0.053***	1.24**	0.339**	0.310
Urban households included	0.068**	2.19**	0.268*	0.864**
Blue-collar only	0.002	0.318	-0.039	0.263
Not grouped by income/expenditure	-0.080***	-0.60***	-0.43***	-0.080
Grouped by income and other factors	-0.026	-0.349	-0.184*	-0.030
Groups means estimated	0.049***	1.19**	0.126	050**
Sampling method(default=unknown)				
Non-random, nonrepresentative	-0.017	-0.36	-0.007	-0.261
Non-random. representative	-0.024	-0.19*	-0.133	-0.903
Stratified random sampling	-0.033	-0.67	0.029	-0.793
R^2	0.63	0.61	0.59	0.62
N	132	132	132	132

Notes: inequality statistics estimated from 132 surveys from 14 countries, using the simplest interpolation methods. Country controls included. *, **, *** signify conventional significance at the 10%, 5% and 1% levels.

Table 6. Understanding the variations in European working household inequality 1890-1960

Beta-Lorenz Dep. Var.:	Gini	90/10	90/50	50/10
Explanatory factors:				
Era: (default=post 1939)				
Before 1920	-0.013	-0.045	-0.017	-0.005
1920-1939	-0.007	-0.055	-0.031	0.008
Post 1939*Stratified Random	0.070	1.752**	0.123	0.792***
Survey design				
Rural households included	0.055***	1.069***	0.213***	0.309**
Urban households included	0.082**	1.070**	0.173	0.393*
Blue-collar only	-0.002	0.064	-0.025	0.067
Not grouped by income/expenditure	-0.094***	-0.523	-0.234	-0.099
Grouped by income and other factors	-0.044**	0.088	0.022	0.003
Groups means estimated	0.060***	0.687**	0.051	0.314***
Sampling method(default=unknown)				
Non-random, nonrepresentative	-0.015	-0.305	-0.068	-0.083
Non-random. representative	-0.022	0.395	-0.180*	-0.010
Stratified random sampling	-0.040	-0.833	-0.08	-0.349
R^2	0.64	0.72	0.65	0.64
N	132	132	132	132

Notes: inequality statistics estimated from 132 surveys from 14 countries, using the simplest interpolation methods. Country controls included. *, **, *** signify conventional significance at the 10%, 5% and 1% levels.

Appendix 1: Data reference list

Austria

Handelsministerium, Wirtschaftsrechnungen und Lebensverhältnisse von Wiener Arbeiterfamilien, 1912-1914 (Wien, 1916)

Benedikt Kautsky, 'Die Haushaltstatistik die Wiener Arbeiterkammer, 1925-1934', International Review for Social History, Vol. 2, No. Supplement S1 (1937)

Kammer fur Arbeiter und Angestellte, Lohne und Lebenshaltung der Wiener Arbeiterschaft im Jahre 1925 (Wien: Verlag der Kammer fur Arbeiter und Angestellte, 1928)

Belgium

Edouard Ducpetiaux, Budgets economiques des classes ouvrieres en Belgique (Bruxelles, 1855)
Ernst Engel, Die Lebenskosten belgischer arbeiterfamilien fruher und jetet (1895)
Sixth Annual Report Of The Commissioner Of Labor, 1890. Cost Of Production: Iron, Steel, Coal, Etc. (Washington D.C.: United States Government Printing Office, 1891.
Ministere de l'Agriculture etc., Salaires et budgets ouvriers en Belgique au mois d'avril 1891 (Bruxelles, 1892)
B.S. Rowntree, Land and Labour: Lessons from Belgium (London: MacMillan and Co., 1910)
Auguste Slosse and Emile Waxweiler, Recherches sur le travail humain dans l'industrie 1. Enquete sur l'alimentation de 1065 ouvriers belges (Bruxelles: Misch & Thron, 1910)
Great Britain Board of Trade, Cost of Living in Belgian Towns. Report of An Enquiry by the Board of Trade into Working Class Rents, Housing and Retail Prices, together with the Rates of Wages in certain occupations in the Principal Industrial Towns of Belgium. (London: H.M.S.O., 1910
'The Belgian Family Budget Enquiry of 1928-1929', International Labor Review, Vol. 30, No. 1 (1934).
G. Jacquemyns, te sur les conditions de vie de meurs s (Liege: G. Thone, 1932)
G. Jacquemyns, L'alimentation dans les budgets familiaux, 1947-1948 (1950)
G. Jacquemyns, Mode de vie des ouvriers, 1948-49 (Bruxelles: Parc Leopold, 1951)
European Community for Coal and Steel, WIRTSCHAFTSRECHNUNGEN der Arbeiterfamilien der E G K S 1956/57, Serie Sozialstatistik (1960)
Schweiz. Staatssekretariat r Wirtschaft., 'Enquete de 1958 sur les budgets familiaux de salaries', La vie economique, Vol. 11 (Novembre 1959)
Institut National de Statistique, 'Enquete sur les budgets de menage 1961-62', Statistiques Économiques Belges 1960-1970, Vol. 1: Notices

Denmark

Danmarks Statistik, 'Danske Arbejderfamiliers Forbrug 1: Afdeling: Byarbejdere', Statistiske Meddeleser, Vol.4.6., No. 6 (1900)

Danmarks Statistik, 'Danske Husholdingsregnskaber: 1: Afdeling: Byarbejdere', Statistiske Meddelelser, Vol. 4, No. 40 (1912)

Danmarks Statistik, 'Danske Husholdningsregnskaber 2: Afdeling: Arbejdere og Haandvaerkere paa Landet', Statistiske Meddelelser, Vol. 4, No. 40 (1912)

Danmarks Statistik, 'Husholdningsregnskaber for 1922', Statistiske Meddelelser, Vol. 4, No. 69 (1925)

Danmarks Statistik, 'Husholdningsregnskaber 1931', Statistiske Meddelelser, Vol. 4, No. 100 (1936)

Statistiske departement, 'Husholdningsregnskaber I Aaret 1/4 1939 - 29/3 1940, og I 4 Ugers Perioden 11/4 - 8/5 1942', Statistiske Meddelelser (1944)

Statistiske departement, 'Husholdningsregnskaber I Aaret 1/4 1939 - 29/3 1940, og I 4 Ugers Perioden 11/4 -8/5 1942', Statistiske Meddelelser (1944)

"Post-War Studies of Family Expenditures", International Labour Review, Vol. 74, Issue 6 (December 1956), pp.576-599. (1956)

Kjeld Bjerke, An Analysis of the Personal Income Distribution for Wage and Salary Earners in 1955 (Kobenhaven, 1964)

Finland

Vera Hjelt, Tutkimus ammattityolaisten toimeentulo ehdoista Suomessa 1908-1909 PART 2 - TABLES (Helsinki,1912)
Suomen Virallinen Tilasto, Elinkustannukset tilinpitokaudella, 1920-21 (Helsinki, 1925)
'The Finnish Family Budget Enquiry of 1928', International Labour Review, Vol. 30, No. 2 (1934)
'Elinkustannustutkimus helmikuu 1950- tammikuu 1951', Finlands Officiella Statistik, Vol. SocialaSpecialundersokningar XXXII (1954)
Suomen Virallinen Tilasto, Maaseudun Kulutustutkimus: Konsumtionundersökningen pa Landsbygden (Helsinki: Sosiallista Erikoistutkimuksia, 1962)

France

UK Board of Trade memoranda, statistical tables and charts with reference to various matters bearing on British and foreign trade, cd.1761, 1903 Original: Enquete faite par le Manuel General de l'Instruction Primaire sur les conditions de la vie des Instituteurs (Libr (1903)

Maurice Halbwachs, 'Budgets de familles ouvrieres et paysannes en France en 1907', Bulletin de la statistique generale de la France, Vol. IV, No. I (1914)

Great Britain Board of Trade, Cost of Living in French Towns. Report of an enquiry into working class rents, housing and retail prices, together with the rates of wages in certain occupations in the principle industrial towns of France (London: H.M.S.O., 1909

L. Duge de Bernonville, 'Enquete sur les conditions de la vie ouvriere et rurale en France en 1913-1914', Bulletin de la Statistique generale de la France, Vol. VI, No. II (1917)

Henry Delpech, Recherches sur le niveau de vie et les habitudes de consommation, Toulouse 1936-1938 (Paris: Librairie du Recueil Sirey, 1938)

Enquete de l'Institut National des Etudes Demographiques, 'Les conditions d'existence des familles. Les dépenses de 1.080 familles en mars et en juin 1946' Population (French Edition), Vol. 2, No. 2 (Apr. - Jun., 1947), pp. 243-266 (1947)

Institut National de la Statistiques et des Etudes Economiques, 'Les Depenses De Certaines Familles de Salaries au printemps 1948. A Auxerre, Lyon, Marseille', Bulletin de la Statistique Generale de la France (Supplement Oct.-Dec. 1949)

Alain Girard, "Les conditions d'existence des familles. Dépenses et ration alimentaire en janvier-février 1948", Population (French Edition), Vol. 3, No. 2 (Apr-Jun 1948)

I.N.S.E.E., 'Institut National de la Statistiques et des Etudes Economiques, 'Premiere results concernant les depenses des familles de salaries de la region Parisienne, au Printemps 1948", Bulletin de la Statistique Generale de la France: Supplement Janvier-Mars 1949 (1949)

Institut National de la Statistiques et des Etudes Economiques, 'Les Depenses et les Consommations des Familles de Salaries de la Region Parisienne Pendant L'Autonme 1948', Bulletin de la Statistique Generale de la France, Vol. , Supplement Oct.-Dec. (1949)

Enquête de l'I.N.S.E.E. et de l'I.N.H, 'Les budgets de familles de salariés dans quelques grandes villes de province, hiver 1949-1950 et automne 1950'. Supplement trimensuelle de la Bulletin Mensuelle de Statistiques, janvier-mars 1953. (1953)

'Une enquête par sondage sur l'alimentation et les depenses des menages d'ouvriers mineurs du group de Lens', Bulletin Mensuel de Statistique, Vol. Supplement Oct-Dec (1952)

I.N.S.E.E., 'Une enquête sure les dépenses des ménages des exploitants agricoles en 1952', Bulletin Mensuel de Statistique Supplement Juillet-Septembre (1954)

Budgets des Francais en 1956 : depenses et niveaux de vie : compte rendu d'une enquete. (1960)

Germany

E. Wurm, Die Lebenshaltung der deutschen Arbeiter : ihre Ernohrung und Wohnung, Einkommen, indirekte Besteuerung, Erkrankung und Sterblichkeit : nebst einem Anhang, Die Zusammensetzung der Nahrungsmittel (Dresden, 1892)

Great Britain Board of Trade, Report of an Enquiry into Working Class rents, housing and retail prices, together with the rates of wages in certain occupations in the principal industrial towns in the German Empire (London: H.M.S.O., 1908)

Statistisches Reichsamt, Erhebung von Wirtschaftsrechnungen Minderbemittelter Familien in Deutschen Reiche, Sonderheft zum Reichs Arbeitsblatt. [Part 2] (1909)

Deutscher Metallarbeiterverband, Haushaltungsrechnungen von Metallarbeitern (Stuttgart: Schlicke, 1909)

Ernst Herbig, Wirtschaftsrechnungen Saarbrücker Bergleute (Berlin: Verlag von Wilhelm Ernst & Sohn, 1913)

Abteilung fur Arbeiterstatistik Abteilung fur Arbeiterstatistik, 'Die Erhebungen des kreigsausschusses fur konsumenteninteressen uber die lebenshaltung im kriege. Die Erhebung vom Juli 1916', Reichs-Arbeitsblatt, Vol. 15, No. 3 (1917)

Waldemar Zimmermann, 'Die Veränderungen der Einkommens und Lebensverhältnisse der deutschen Arbeiter durch den Krieg' im 'Die Einwirkung des Krieges auf

Bevölkerungsbewegung, Einkommen und Lebenshaltung in Deutschland' (Stuttgart, Berlin und Leipzig: Deut (1932)

Beitrage zur Kenntnis der Lebenshaltung im vierten Kriegsjahre (Statistisches Reichsamt, 1919)

Statistisches Reichsamt, Die Lebenshaltung von 2,000 Arbeiter-, Angestellten- und Beamtenhaushaltungen. Erhebungen von wirtschaftsrechnungen im Deutschen Reich vom Jahre 1927-1928, Einzelschriften zur Statistik des Deutschen Reichs (Berlin, 1932)

Deutschen Reichsbahngesellschaft, Die Lebenshaltung des deutschen Reichsbahnpersonals: Ergebnisse einer Erhebung von Wirtschaftsrechnungen unter den Arbeitern und Beamten der deutschen Reichsbahngesellschaft (Berlin: Deutschen Eisenbahner G.M.B.H., 1930)

Dr. Luise Breuer, Die Lebenshaltung der Bergarbeiter im Ruhrgebiet: Eine haushaltungsstatistische Untersuchung (Muenster: Verlag von Gustav Fischer, 1935)

Post-War Studies of Family Expenditures', International Labour Review, Vol. 74, No. 6 (1956)

Preise Lohne Wirtschaftsrechnungen: Reihe 13: Wirtschaftsrechnungen. Sonderheft 5 Verbrauch in Haushalten von Arbeitern der Montan-Industrien 1956/57 (Stuttgart und Mainz: W. Kohlhammer Verlag, 1961)

Preise Lohne Wirtschaftsrechnungen: Reihe 18, Einkommens und Verbrauchsstichproben; Gesamtausgaben der privaten Haushalte 1962/63 (Stuttgart und Mainz: W. Kohlhammer Verlag, 1966)

Greece

International Labour Office, Family Budget Enquiries in Greece (1929)
Household Expenditure Survey: Carried out in the urban areas of Greece during the years 1962/63 up to 1968/69 (Athens, 1972)
National Statistical Service of Greece, Household Survey: Carried out in the urban areas of Greece during 1957/58 (Athens, 1961)
National Statistical Service of Greece, Household Survey: Carried out in the semi-urban and rural areas of Greece during 1963/64 (Athens, 1969)

Ireland

Dataset: British Living Standards Project, 1904 Board of Trade Survey
C.D. LaTouche and T.J. Stafford, Notes on the Social Condition of Certain working class families in Dublin (1907)
Ministry of Economic Affairs, Report on the Cost of Living in Ireland (Dublin, 1922)
Household Budget Inquiry 1951-1952 (Dublin: Stationary Office, 1954ILO, 'Post-War Studies of Family Expenditures [notes]', International Labour Review, Vol. 74, No. 6 (December 1956)

Netherlands

Bureau van Statistiek, De uitgaven van 114 ambtenaars- en arbeiders gezinnen, Les penses de 114 nages de fonctionnaires et d'ouvriers (Amsterdam: J.M. Meulenhoff, 1924)

Bureau van Statistiek, Huishoudrekeningen van 212 gezinnen uit verschillen de kringen der bevolking (Amsterdam: J.M. Meulenhoff, 1927)

Centraal Bureau voor de Statistiek, Huishoudrekeningen van 598 gezinnen uit verschillende deelen van Nederland over de perioden 29 Juni 1935 t/m 26 Juni 1936 en 28 Sept. 1935 t/m 25 Sept. 1936. (The Hague, 1937)

Centraal Bureau voor de Statistiek, Nationaal Budgetonderzoek 1951, Methodologische inleiding (Utrecht: W. De Haan, 1953)

Statistical office of the Europena Communities, WIRTSCHAFTSRECHNUNGEN der Arbeiterfamilien der E G K S 1956/57 (1960)

Norway

Norges Statistisk Sentralbyrå, 'Skatternes fordeling efter indtægt og forsørgelsesbyrde Kristiania', Socialstatistik (1909)

Norges Statistisk Sentralbyrå, 'Husholdningsregnskaper for handelsfunktionærer' (1913)

Christiania Municipal Bureau of Statistics, ' Husholdningsregnakaper fort au endel mindre bemidlede familier Kristiania, Bergen, Trondhjem, Drammen, Kristianssand, Og Hamar I Aaret 1912-13' (1915)

Norges Statistisk Sentralbyrå, ' Husholdningsregnskap 1918', Norges officielle statistik, Vol. 7, No. 13 (1921)

Norges Statistisk Sentralbyrå, "Husholdningsregnskap, 1927-28', Norges officielle statistik, Vol. 8, No. 103 (1929)

Norges Statistisk Sentralbyrå, 'Husholdningsregnsaper mai 1947 - april 1948', Norges officielle statistik, Vol. 11, No. 23 (1950)

Norges Statistisk Sentralbyrå, 'Husholdningsregnskap 1951', Norges officielle statistik, Vol. 11, No. 128 (1953)

Norges Statistisk Sentralbyrå, 'Forbruksundersøkelse etter intervjumetoden 1952', Norges officielle statistik, Vol. 11, No. 131 (1953)

Norges Statistisk Sentralbyrå, 'Husholdningsregnskaper for høyere funksjonærer [1954] ', Norges officielle statistik, Vol. 11, No. 157 (1954)Norges Statistisk Sentralbyrå, 'Husholdningsregnskaper for jordbrukerfamilier, 1957', Norges officielle statistik, Vol. 11, No. 274 (1957)

Norges Statistisk Sentralbyrå, 'Husholdningsregnskaper for fiskerfamilier (1957) ', Norges officielle statistik, Vol. 11, No. 250 (1957)

Norges Statistisk Sentralbyrå, 'Husholdningsregnskaper for alderstrygdede (1958) ', Norges officielle statistik, Vol. 11, No. 274 (1958

Norges Statistisk Sentralbyrå, 'Forbruksundersøkelsen 1958', Norges officielle statistik, Vol. A7 (1960)

Poland

Woycicki, "L'ouvrier poland", reforme sociale, 79, 433-443. 80 506-515. (1909).
Glowny Unzad Statystyczny, 'Budzety Rodzin Robotniczych 1927', Statyska Polski, Vol. 40, No. 1 (1930)

Edward Otrebski, Budzety Domowe Rodzin Robotniczych w Latach 1927 I 1928 (Warsaw, 1931)
Central Office of Statistics, Budgets des familles ouvrieres, tome XL, fascicule 2 (Warsaw, 1933); International Labour Review, 28, p. 870, (1933)
Otrebski, "Wyniki badania budzetow domowych pracownikow umyslowych przeprowadzonego w maju" 1932", Statyatyka Pracy, 11 (4): 345-366, 1932 (1932)
Maria Czerniewska, Buzety domowe rodzin chłopskich : praca nopisana w Instytucie Ekonomiki Rolnej (Warszawa: stwowe Wydawnictwo Ekonomiczne, 1963)

Sweden

Statistika Kontoret, Statistisk Undersökning Angaende Levnadskostnaderna I Stockholm Aren 1907-8 (Stockholm, 1910)

K. Socialstyrelsen, Levnadskostnaderna I Sverige 1913-1914. (Stockholm: Sveriges Officiella Statistik, 1919)

Kungl. Socialstyrelsen, ' Livsmedelsforbrukningens Omlaggning under Kristider', Sociala Meddelanden (1917)

K. Socialstyrelsen, Livsmedelsforbrukningen inom Mindre Bemedlade Hushall under Krisaren 1914-1918 (Stockholm: Sveriges Officielle Statistiek, 1922)

Kungl. Socialstyrelsen, Levnadskostnaderna pa Lundsbygden I Sverige vid ar 1920 (Stockholm, 1923)

Statistiska Centralbyran, 'Inkomster och Utgifter för arbetare- och medelklasshushåll åren 1913/14, 1920 och 1922/23.', Statstisk Arsbok for Sverige (1928)

K. Socialstyrelsen, Levnadskostnaderna I stader och industriorter omkring ar 1923 (Stockholm: P.A. Norstedt & Sonner, 1929)

International Labour Review, 'Recent Family Budget Enquiries: The Swedish Family Budget Enquiry of 1933', International Labour Review, Vol. 31 (1935)

K. Socialstyrelsen, 'Levnadsvillkor och hushållsvanor för arbetare på landsbygden omkring år 1934', Sociala Meddelanden, Vol. 6 (1935)

Kungl. Socialstyrelsen, 'Levnadsvillkor och hushållsvaror inom smabrukar och bondefamiljer ar 1933/34', Sociala Meddelanden (1936)

K. Socialstyrelsen, 'Levnadsvillkor och hushållsvanor för arbetare på landsbygden omkring år 1934', Sociala Meddelanden, Vol. 6 (1935)

Kungl. Socialstyrelsen, Hushållsbudgerer och livsmedelskonsumtion i t der och t torten 1940-1942 = (Les budgets familiaux et la consommation des denrees alimentaires dans les villes et autres agglomerations, 1940-1942). (Stockholm: P.A. Norsdedt & Soner, 1946)

K. Socialstyrelsen, 'Hushållsbudgetundersökning på grundval av postsparbankens budgetböcker', Sociala Meddelanden, Vol. 3 (1945)

K. Socialstyrelsen, 'Konsumtionsvanorna under år 1947', Sociala meddelanden, Vol. 2 (1949)

Kungl. Socialstyrelsen, Levnadskostnaderna I tartortshushall ar 1948 (Stockholm: Emil Kihlstroms Tryckeriaktiebolag, 1953)

Kungl. Socialstyrelsen, Levnadskostnaderna pa landsbygden ar 1951 (Stockholm: K.L. Beckmans, 1955)

Kungl. Socialstyrelsen, Hushallens Konsumtion ar 1958 (Stockholm, 1961)

Switzerland

Office Federal du Travail, 'Budgets de Familles tenus en Suisse durant l'annee 1921. Compares avec des budgets tenus en 1912, 1919, 1920', Information Statistique Sociale, Vol. 2 (1923)

Basel-Stadt. Statistisches Amt., 'Haushaltungsrechnungen von Basler Familien aus den Jahren 1912, 1919, 1923', Mitteilungen des statistischen Amtes des Kantons Basel-Stadt, No. 45 (1925)

Zurich Statistisches Amt, Zurcher Haushaltsrechnungen aus dem Jahre 1919: ein Beitrag zur Kanntnis der Lebenshaltung, Zurich Household Accounts from 1919: A Contribution to the Knowledge of Living Standards (Zurich, 1921)

Basel-Stadt. Statistisches Amt., 'Haushaltungsrechnungen von Basler Familien aus den Jahren 1912, 1919, 1923', Mitteilungen des statistischen Amtes des Kantons Basel-Stadt, No. 45 (1925)

Office Federal du Travail, 'Budgets de Familles tenus en Suisse durant l'annee 1921. Compares avec des budgetstenus en 1912, 1919, 1920', Information Statistique Sociale, Vol. 2 (1923)

Statistische Mitteilungen des Kantons Zurich, eit ge zur Wirtschaftsstatistik : Haushaltungsrechnungen aus der Stadt Winterthur und den Landgemeinden des Kantons betreffend die Jahre 1912, 1919 und 1920 : … bet effend die Jahre 1921 und 1922., Statistische Mitteilungen des Kantons Zurich, 141 ; 150 (Winterthur, 1922-1925., 1925)

"Food consumption of working class families in certain countries", International Labour Review, 1933, 28, 870. (1933)

Basel-Stadt. Statistisches Amt., 'Haushaltungsrechnungen von Basler Familien aus den Jahren 1912, 1919, 1923', Mitteilungen des statistischen Amtes des Kantons Basel-Stadt, No. 45 (1925

Switzerland Arbeitersekretariat, Die Lebenshaltung schweizerischer Arbeiter und Angestellter vor dem Kriege: Ergebnisse der Haushaltstatistik des Schweizerisches Arbeitersekretariat (Zurich: Kommissionsverlag von Hermann Hambrecht, 1922)

Bureau de Statistique, Comptes de menage de 277 familles suisses pour 1919 (Berne: Francke, 1922)

Zurich Statistisches Amt, Zurcher Haushaltsrechnungen aus dem Jahre 1919: ein Beitrag zur Kanntnis der Lebenshaltung, Zurich Household Accounts from 1919: A Contribution to the Knowledge of Living Standards (Zurich, 1921)

Statistisches Amt der Stadt Bern, 'Stadtbernische Haushaltungsrechnungen 1912, 1918-23 und 1936-38',

Statistisches Jahrbuch der Stadt Bern, Vol. Anhang 1 (1941/42)

Wilhelm Bickel, 'Zurcher Haushaltungsrechnungen, 1936/37', Statistisches Amt der Stadt Zurich, No. Statistik der Stadt Zurich, H. 47 (1938)

Statistisches Amt der Stadt Bern, 'Stadtbernische Haushaltungsrechnungen 1912, 1918-23 und 1936-38',

Statistisches Jahrbuch der Stadt Bern, Vol. Anhang 1 (1941/42)

ILO, 'Post-War Studies of Family Expenditures [notes]', International Labour Review, Vol. 74, No. 6 (December 1956)

UK

Dr. Edward Smith, Report on the Food of the Poorer Labouring Classes in England, Medical Officer of the Privy Council: Sixth Report, 1963 (London: H. M. S. O., 1864)

British Parliamentary Papers, (1905) *Consumption and the Cost of Food in Workmen's Families in Urban Districts of the United Kingdom*, Cd 2337

Gazeley, Ian, Andrew Newell, Michael Hawkins, James Walker and Peter Scott (2013), 'Living standards of working households in Britain, 1904-1960 - Board of Trade Household 18 Survey, 1904 , Ministry of Labour Household Survey, 1937-8, Ministry of Labour Household Survey, 1953-4.' Dataset deposited at the UK Data Archive as SN 85093

Appendix 2: Testing alternative methods of estimating inequality from grouped data.

In order to sketch our methods here, we present some results from testing for the biases of different estimators of inequality measures. The testing approach employs bootstrap sampling. We repeatedly drew random subsamples from two different individual data sets, and from each subsample create a grouped data set this data is then tabulated with vary number of income groups created. Then for each set of grouped data, we make up to six different estimates of the Gini coefficient and various decile ratios using various estimation methods. We then compare these estimates with the inequality measure taken directly from the subsample of individual households, the average of the differences between these two measures across the 500 repetitions, is thus the bias of the estimators. The estimates were drawn for tabular data grouped by income ranging between 5 to 10 groups, as these are the most frequest numbers of groups in the tables we located.

Consider Table A1, which is taken from Gutierrez Rufrancos and Newell (2017). The data used to generate this table were from BMinistry of Labour (). The table provides the evaluation of six methods for income inequality estmatioinm, as listed in the first column. Each cell can thus be thought of as our assessment of the bias associated with using this estimation technique. The 'Groups Naïve Frequency Method' simply assigns the group average income to each household in the group and then calculates the Gini coefficient using the usual unit record formulas[6] Thus we find that this first method overestimates the Gini on this dataset by between one and two points on average.

The second row gives the bias, similarly defined, of using Hermite interpolation within the groups, , as suggested by Gastwirth and Glauberman (1976).Gutierrez Rufrancos The third row reports the bias from a parametric approach, estimating lognormal parameters from an interval regression exploiting the upper and lower bounds of the groups. The fourth method simply estimates lognormal with an ordinal least squares regression on group means. The fifth method estimates Kakwani's Beta Lorenz curve (Kakwani, 1980), and the sixth method combines Hermite-interpolation with Beta Lorenz estimation see Gutierrez Rufrancos and Newell *op. cit.* for a discussion.

[6] In practice this was estimated using Jenkins (1999) module for unit record estimation in Stata -ineqdeco-.

Table A1: Bias on Estimates of Gini Coefficient using Income from Group data, UK 1953/4

# of Bins (Groups)	5	6	7	8	9	10	Rank
Groups Naive Freq. Weighted	0.010	0.014	0.017	0.018	0.019	0.020	1
Hermite Interpolation (bands)	0.041	0.038	0.036	0.034	0.033	0.031	5
Lognormal interval regression (bands)	0.014	0.017	0.019	0.021	0.023	0.024	2
Lognormal OLS	0.046	0.048	0.057	0.060	0.064	0.074	6
Beta-Lorenz	0.027	0.027	0.027	0.026	0.026	0.026	4
Hermite-Beta Lorenz (bands)	0.044	0.033	0.025	0.021	0.018	0.014	3

Notes to Table 1. Each cell gives the mean bias from 100 bootstrap replication of each group data estimation method, by the assumed number of bins or groups.

The last column of Table A1 ranks the estimators inversely with the size of the mean bias across the different number of group sizes. Across both datasets, Gutierrez Rufrancos and Newell op. cit. find the least-biased estimator to be the Beta-Lorenz. It characterises the decile ratios very well. It does not, however, provide the best estimate of the Gini coefficient. Where the data only provides interval information, the best estimator is the combination of the Beta-Lorenz and the Hermite interpolation. However, in some extreme cases this fails to resolve numerically the non-linear least squares. When this is the case, the suggested second-best performer is the interval regression based lognormal estimator. As a result, eleven of our twenty-five inequality estimates based on grouped data are estimated by Hermite-interpolated-Beta Lorenz, eight are estimated by Beta-Lorenz and six by the interval based lognormal estimator.