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ABSTRACT

Escaping from Hunger before WW1: Nutrition and Living Standards in Western Europe and USA in the Late Nineteenth Century

We estimate calories available to workers' households in the USA, Belgium, Britain, France and Germany in 1890/1. We employ data from the United States Commissioner of Labor survey (see Haines, 1979) of workers in key export industries. We estimate that households in the USA, on average, had about five hundred daily calories per equivalent adult more than their French and German counterparts, with Belgian and British workers closer to the USA levels. We ask if that energy bonus gave the US workers more energy for work, and we conclude that, if stature is taken into account, workers in the US and UK probably had roughly the same level energy available for work, whereas the German and French workers most likely had significantly less. Finally we ask economic migration leads to taller children. To answer that we estimate the influence of children on calorie availability among ethnically British workers in the USA and, separately, among British workers in Britain. We find that US-based British households are at least as generous in terms of the provision of calories to their children as their Britain-based counterparts. Other things equal, this means that US-based British children would grow taller.

JEL Classification: J11, J61, N30
Keywords: living standards, nutrition, international comparisons, migration

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Introduction

In *The Changing Body* (2011), Floud *et al* develop the analysis of the relationship between nutrition, physical work, stature and labour productivity during the early phases of the demographic transition, first outlined by Fogel (2004) in *The Escape from Hunger and Premature Death, 1700-2100*.[1] During the eighteenth and nineteenth centuries in Europe and America, the move to industrial production required more physically demanding work (of at least 10 hours hard labour a day). According to Floud *et al* (2011), the diet required to fuel this intensity of work had to produce at least 3,500 kcal per day, even allowing for the relatively slight average stature of nineteenth century workers and, by modern standards, their stunted average heights. They argue that during the nineteenth century average 'physiological capital' rose, as diets provided more energy, which allowed both height and stature and labour productivity to increase. In turn, this increase in dietary energy reduced pauperism, as a greater proportion of the labour force was able to sustain demanding work and/or resources were transferred within the household from women and children to breadwinning adult males.[2] According to Fogel (2004:18-19), this transition was well advanced, though not complete by the late nineteenth century:

> The prevalence of meagre diets in much of Europe, and the cycling of stature and mortality even in a country as bountiful in food as the United States, shows how persistent misery was down almost to the end of the nineteenth century and how diverse were the factors that prolonged misery.

While Fogel and Floud *et. al.* provide good comparative data on heights in the United States, Great Britain and Europe, the evidence on energy availability is not as geographically wide ranging, and is based on production, rather than consumption data. On the basis of production data Floud *et. al.* estimate that in the US in 1890, energy availability was 3,134 kcal per capita[3] and 2,977 kcal for England and Wales in 1909-13.[4]

The aim of this paper is to investigate international differences in energy availability derived directly from household consumption data, and compare these with estimates of the energy required to sustain up to 10 hours' hard manual labour a day, taking account of

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[1] Floud *et al* (2011) pp.164-168 and pp 311- 317 and Fogel (2004) pp.8-19.

[2] Floud *et al* (2011)p.168

[3] Floud *et. al.* p.314 Table 6.6

[4] Floud *et. al.* p.161 Table 4.10

variations in sex, age and body stature across four European countries and the United States. In so doing, we aim to chart international variations in the extent to which industrial workers had been able to escape hunger in their country of birth in the late nineteenth century. But not everyone lived and died in the same country. International migration rates were historically high in the late nineteenth century, as workers and their families in Europe tried to escape hunger at home by emigrating to the New World. Using the same household expenditure data, we also investigate the nutritional welfare gain associated with migration from Europe to America at this time.

In section 1 of this paper we evaluate the United States Commissioner of Labor's 1889/90 household survey that forms the basis of this investigation, noting that it was a biased sample of the industries covered, and that the biases varied across the countries included in the survey. We discuss how these concerns can be mitigated using propensity-matching techniques in the appendix A1 to this paper. In Section 2 we discuss the evolution of modern standards of nutritional adequacy and the difficulties associated with the use of household expenditure survey material for nutritional analysis. In appendix A2 we provide details of the foods included in this analysis, along with details of the calories they provide. Section 3 reports our estimates of household energy availability from the survey data by country, making simple and propensity-matched international comparisons. Overall, we show that in terms of energy available per equivalent adult per day, there was on average a deficit of about 500 calories between Europeans and Americans. These estimates of energy availability are evaluated relative to energy requirements in Section 4, taking account of differences in physical stature, physical activity levels based upon declared occupation, age and sex. Adjusting for differences in stature is important for international comparisons of energy availability relative to modern standards. This is especially true in the context of a UK-USA comparison, where adjusting for stature, eliminates an apparent UK deficit. Finally, in Section 5, we evaluate the nutritional welfare gain associated with migration from Europe to the United States of America and show that Europeans could eliminate any energy shortfall in their diets by migrating from the old to the new world.

Section 1: The survey.

This article is based on the analysis of data collected by the US Commissioner of Labor, 1888-1890 (hereafter USCL). This was the first large-scale international survey of living standards and was based upon the collection and analysis of 8,544 household budgets. The 1890 and 1891 *Sixth and Seventh Reports* of the United States Commissioner of Labor have been widely used in the years since the data was first extracted by Haines (1979). Because of its value as a large-scale trans-national survey, a number of attempts have been made to explore the likely biases of the dataset but, despite this scholarship, the method of implementation of the USCL survey is known only in the most general terms. The survey was implemented during Carroll D. Wright's tenure at the Massachusetts Bureau of Statistics of Labor. According to Williamson, Wright had developed and perfected advanced census techniques in a number of enquiries before the *Sixth Annual Report* in 1890.[5] The *Sixth* and *Seventh Reports* were motivated by the McKinley Tariff question. This led the Commissioners to focus exclusively on export industries in the countries studied. To this end, Wright was interested in data relating to the cost of production and the cost of living in nine industries in Europe and America (Pig Iron, Bar Iron, Steel, Coal, Coke, Iron Ore, Cotton, Wool, Glass),[6] which were all already protected industries in America. Data was collected for twenty-four states in America and five European countries (Belgium France, Germany, Great Britain and Switzerland).[7]

Williamson points out that the *Reports* represent the combination of results of two separate surveys – iron, steel and coal in 1888-1890 and textiles and glass 1888-91.[8] Nearly one third of the international sample related to cotton textiles (31.8 per cent), while less than one in ten related to steel coke and iron ore (9.9 per cent). [9] Moreover, the vast majority of these households were from the United States [6,809], with those from the United Kingdom [1,024] comprising the second largest group. There are relatively few households from Continental European countries contained within the sample [France 335, Belgium 124, Germany 200, Switzerland 52].

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[5] Williamson, J.G. Consumer Behavior in the Ninetieth Century: Carroll D. Wright's Massachusetts Workers in 1875' p.102-3

[6] Ibid. p.105

[7] Haines, Michael, 'Industrial Work and the Family Life Cycle, 1889-1890', *Research in Economic Hist*ory, Vol 4 pp.289-356. (1979) p.293

[8] Cited in Logan (2006) p.316.

[9] Haines (1979) p.293

The Reports are of fixed-format structure and provide comprehensive details of household structure and characteristics, income and expenditures, converted from local currency and reported in annual US dollars. According to Haines, the vast majority (97.8 per cent) of the families across the entire survey were male headed.[10] The published reports themselves provide only the briefest of description of the way in which families were selected and family structure and expenditure information recorded. An oft-quoted passage of the Report states (in relation to Pig Iron):

> The Department has aimed to secure accounts from a representative number of the employees of the establishments...and also from those families whose surroundings and conditions made them representative of the whole body of employees in any particular establishment. The representative character, however, has been impaired in some measure by two features: first some families have not been willing to give the information desired; while second, other families, perfectly willing, have not been able to give reasonably exact accounts of their living expenses.[11]

The Report continues to highlight the fact that the families were asked to keep 'accounts for a year's living' and that the word family is actually used to describe households, as the family is meant as a 'totality - husband wife, children, boarders, everybody that goes to make up the household.'[12] According to Lees, the head of the travelling commissioners claimed that employers supplied wage data and that 'home visits were made in the company of trusted local people to ask for information when regular accounts were not kept.'[13] It was Henry Higgs, a contemporary writing in 1893, who, according to Lees, guessed that the yearly totals were estimated from records kept over a much shorter period.[14]

Since this survey was focussed solely on export trades, it is a highly selective sample of industrial workers in each of the countries studied. A number of writers have attempted to investigate the extent to which the USCL survey was representative of workers in those export industries in the 1890s. According to Logan (2006), most of this scholarship has concluded that the US households selected 'appear to be broadly representative of the

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[10] Haines p.293-4. Haines' investigation of the life-cycle and labour force activity, based on the analysis of the household budgets for all the industries in all countries (8544 families). 'Industrial Work and the Family Life Cycle, 1889-1890', *Research in Economic Hist*ory, Vol 4. pp.289-356. 1979

[11] Sixth Annual Report of the United States Commissioner of Labour pp.610-11. This same passage is quoted by Haines, Hatton and Bailey

[12] ibid p.611

[13] Lees, Lynn Hollen ' 'Getting and Spending: The Family Budgets of English Industrial Workers in 1890' in *Consciousness and Class Experiences in nineteenth century Eur*ope (London, 1980), p.170.

[14] ibid p.170

industrial households employed in the industries surveyed.'[15] This judgment seems to have been reached largely on the basis of Haines' comparison of the age structure of the survey households in relation to data from the 1890 US Census. A comparison of household size and nominal income levels by country is set out in Table 1. It can be seen from this Table that the American households in the sample were significantly better off in nominal terms than households in any other country.

<<<Insert Table 1>>>>

With respect to the households in the UK sample, Hatton, Boyer and Bailey (1994) found that the skill of the head of household varied across industries such that 'unskilled workers form the dominant group in pig-iron and coke; semi-skilled workers the dominant group in cotton, wool and coal; and skilled workers the dominant group in steel, bar-iron and glass.'[16] Looking at average income by industry, therefore, gives a misleading impression of the hierarchy of high and low wage industries. Overall, therefore, the UK households are a somewhat aberrant sample of the eight industries surveyed and not a representative sample of the industrial working population generally. The continental European budgets of the USCL survey are significantly fewer in number and it is less likely that such small samples will be fully representative of the industries covered. Moreover, the European samples are based on surveys of a smaller number of industries (Germany 7, Belgium 5 and France 3). Only in the USA are all nine industries included in the survey. In the UK, iron ore was not included, in Germany, pig iron and glass were not present and in Belgium, coke, iron ore, cotton and wool were not covered and in France, only bar iron, cotton and wool were included.

Notice, too, in the summary data reported in Table 1, that average household size varies across the sample, with German households being the largest and the British households the smallest. Szreter (1997) describes how textile workers, about one-third of the UK USCL sample, tended to have much smaller families than others. For example, cotton workers' families had, on average 2.1 children in the USCL sample, while steel workers' families had on average 2.7 children. The absence of textile workers in the Belgium sample might

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[15] Logan 2006 p.316

[16] Hatton Boyer and Bailey 1994 p.440

help explain why the average household size is larger. Though it is also worth noting that the German sample does contain textile workers and yet German households were the largest of all countries included in the survey. The UK sample has the smallest household size, followed by the French and then the Americans.

<<<<Insert Table 2>>>>

The international differences in nominal household income were largely due to variations in average husband's pay. As Table 2 shows, a relative small proportion of women were working (other than in France), but variations in children's work between countries did make a significant difference to the household economy. The proportion of households where children were working varies between 0.29 (USA) and 0.51 (Belgium). The relatively low labour market engagement of children in German households, coupled with lower than average husband's pay, are the proximate reasons why the Germans were comparatively poor in nominal terms.[17]

Part of the discrepancy in nominal incomes across the sample is mitigated by the behaviour of prices. The relative cost of food is given in Table 3, which reports the cost of average baskets of sixteen foods purchased by households at prevailing prices in each of the different countries. From this table, it can be seen that it was cheaper to buy a UK basket of these 16 foods at UK prices than at US prices, but also a US basket was cheaper in UK prices than in US prices. Generally, US prices were higher for all continental European baskets and German and Belgian prices were lower for all baskets relative to cost of their own basket at domestic prices. Thus, the discrepancy in nominal incomes between relatively rich American households and relatively poor German households shown in Table 1 was not as great as it appears in real terms.

<<<<INSERT TABLE 3>>>>

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[17] There is a difference in the proportion of childless households. On average European households are less childless than Americans and this is significant. Within Europeans, the Germans are half as likely to be childless than Americans. The proportions are 13.1% for USA and 6.5% for Germany. However, the proportion of children working does not significantly differ across the two countries, even on the conditional sample with children. So childlessness is not the explanation.

The differences in samples between some countries are quite significant. As a consequence we make both 'raw' comparisons of the data and 'matched' comparisons that attempt to control for the idiosyncrasies of the different national samples. We do this using propensity score matching, which is discussed in appendix A1. Overall, while the raw and matched result do differ, assuming that propensity matching suitably adjusts for differences in the national samples, they are not so different as to suggest that a simple raw comparison would be dreadfully misleading and for this reason we report raw comparisons throughout the text.

Section 2: Energy availability and adequacy

Before considering the results of our analysis, it is important to foreground a consideration of some of the difficulties associated with these calculations. These fall into two broad categories relating to (i) the use of recommended energy intakes as measures of adequacy and associated with this, assumptions relating to the choice of physical activity levels, and the impact of stature, gender and age on the assessment of adequate intakes (ii) estimates of energy availability from household budget data.

The Institute of Medicine (2005:107) provide a summary of the biological role of energy in humans:

> Energy is required to sustain the body's various functions, including respiration, circulation, physical work, and maintenance of core body temperature. The energy in foods is released in the body by oxidation, yielding the chemical energy needed to sustain metabolism, nerve transmission, respiration, circulation, and physical work. The heat produced during these processes is used to maintain body temperature. Energy balance in an individual depends on his or her dietary energy intake and energy expenditure.

Governmental and NGO recommended individual intakes for energy (and macro and micronutrients) have evolved over the twentieth century in response to advances in scientific understanding. The US Institute of Medicine (2005) defines the Estimated Energy Requirement (EER) as 'the average dietary energy intake that is predicted to maintain energy balance in a healthy adult of a defined age, gender, weight, height, and level of physical activity consistent with good health.' The EER is the Basal Energy Expenditure (BEE) multiplied by the Physical Activity Level (PAL). The BEE is the Basal Metabolic Rate (BMR) extrapolated to a 24-hour period. The BMR is the 'energy needed to sustain the metabolic activities of cells and tissues, plus energy needed to maintain blood circulation, respiration, gastrointestinal and renal processing'.[18]

The FAO/WHO 1985 recommendations incorporated estimates of BMR derived from Schofield et al's (1985) analysis of age, sex and body mass of 7,173 BMR data points. Schofield et al's BMR estimates have been shown to be too high, especially for Asian populations (see Henry 2005 Table 5), partly due to a preponderance of Italian subjects in the database with high BMR per kilogram derived from studies carried out in the 1930s and 1940s. [19] This finding also implies that both the FAO/WHO 1985 and UK Report of the *Committee on Medical Aspects of Food and Nutrition Polic*y (COMA, Department of Health 1991 recommendations) estimated energy requirements are too high, as these both utilised BMR estimates based on age, sex, and body mass data using Schofield *et al* (1985) estimating equations.[20]

Nevertheless, the subsequent FAO/WHO 2004 Report on *Human Energy Requirements*, having reviewed the evidence and the predictive accuracy of new BMR estimating equations derived from a broader 'geographical and ethnic database', concluded in favour of the continued use of Schofield *et al's* 1985 equations to derive adult recommended energy intakes by age, sex and body mass (FAO/WHO 2004:37). The first break with this methodology was the US National Academy of Sciences Institute of Medicine (2005) report on *Dietary Reference Intakes* that provides estimates of Total Energy Estimates using revised BEE predictive equations (IOM 2005:205-206).

An additional difficulty is the estimation of appropriate Physical Activity Levels. The most recent recommended energy requirements, for example, those produced by the UK Scientific Advisory Committee on Nutrition (SCAN) 2011 and US Institute of Medicine (2005), are based on Total Energy Expenditure estimates derived from the doubly labelled water method (DLW).[21] These are considerably more accurate that those derived from food

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[18] IoM (2005) p.112

[19] Over 50% of the data points of males aged 10 to 60 years relate to Italian subjects in Schofield *et al's* estimating equations. Henry (2005: p.1140)

[20] The COMA 1991 estimates differ slightly from the FAO/WHO 1985 due to the inclusion of 'additional data'. COMA 1991:22

[21] The Doubly Labeled Water method allows for the estimation of total C02 production, and coupled with knowledge of the respiratory quotient of the food consumed during the observation period, energy expenditure can be calculated. CO2 production is estimated from the differential

intake data coupled with a factorial approach to physical activity levels based on questionnaire data, as used to inform the 1985 WHO/FAO and COMA 1991 recommendations.[22]

Despite these scientific advances, we have chosen to utilise the older COMA 1991, rather than the current SACN 2011 recommendations. This is because SACN 2011 'chose a prescriptive approach to estimating energy reference values,' influenced by the recent dramatic increase in obesity and overweight individuals. The current UK 2011 energy intake recommendations are referenced on body weight ranges consistent with 'long-term good health', implying a reduction in obesity and the incidence of overweight individuals if the recommendations are followed [23] This represents a significant departure from previous UK recommendations, which followed the established convention of setting energy intake recommendations equal to the Estimated Average Requirement (EAR), which would maintain energy balance.[24] From the perspective of the investigation of historic data, where under-nourishment, rather than over-nourishment, was the predominant issue, it seems appropriate to work with a recommended standard based on population Estimated Average Requirements. Moreover, the use of COMA 1991, allows comparison with our previous work energy availability in UK historic diets. Nevertheless, in view of the recent research on overestimation of energy requirements based on Schofield *et al* 1985 and the inaccuracies involved with the use of factorial approaches to estimating PALs, we have also undertaken sensitivity tests using BEEs from Institute of Medicine (2005), but their use does not substantially alter our conclusions.

We apply the COMA 1991 standard as a heuristic tool to examine international differences in energy availability relative to a fixed standard of nutritional adequacy. It is not the case, however, that modern standards can be straightforwardly applied to data relating to individuals surveyed a century earlier. For example, the COMA 1991 energy values for

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elimination of water containing two labeled isotopes of hydrogen and oxygen: 2Hydroden2 and 18Oxygen2. 2Hydrogen2 is eliminated only as water, whereas 18Oxygen2 is eliminated as water and carbon dioxide.

[22] SACN 2011 p.1

[23] A BMI of 22.5kg/m2, designed to reduce the incidence of obesity at the current average height of the UK population. SACN p.1

[24] The 2011 EER/1991 EER relationship varies by age group and gender. For adult males, the 2011 EER is marginally higher (3%), significantly higher for adolescent boys (15-18%), but lower for pre-adolescent children of both sexes (6-9%). SACN 2011 summary S52

75kg adult men aged 30-59 years of 2,550 kcal per day are based on an overall PAL for a twenty-four hour period of around 1.4 or 1.5.[25] PAR values reported by in UK 1991 range from 1.4 ('light' occupational and non-occupational activity) to 1.9 (moderate/heavy' occupational activity) and 2.2 (very active' non-occupational activity). Practice in the UK prior to 1991 was to specify different energy requirements for various levels of physical activity that were explicitly related to an individual's occupation (from 'very active' to 'sedentary'). The number of 'very active' occupations has declined over the twentieth century, and leisure activity now generally has a much greater influence on an individual's energy requirements than it did earlier, making a classification based upon occupation less useful today that it was a century ago.[26]

The appropriate EER would have been higher for working-class individuals in 1890 than today because of the preponderance of more energy demanding occupations and longer working hours, despite other factors working in the opposite direction. Individuals in 1890 were generally lighter and of smaller stature, which would have tended to lower BEE, but not enough to offset the higher energy demands of prolonged physically demanding work. In 1890, the stature of adult men varied by country. For those men reaching maturity in the last quarter of the nineteenth century, Floud *et. al.* (2011) give a figure of 168 cm for Great Britain, and 165.4 cm for France. They indicate that German men were likely a little shorter than their French counterparts and American men were probably about 3cm taller on average than those in GB.[27] Belgian men were about 2cm shorter on average than those from Britain, but taller than Frenchmen.[28] These estimates of average height differ slightly from European heights reported in Hatton and Bray 2010.[29]

These height data are doubtless imperfect estimates of the actual average adult male heights in the populations in 1890, as they are originally derived from military height records,

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[25] *Dietary Reference values*, 1991, Table 2.7 p.27. 2550 kcal/d is about 10.6 MJ/d, which for an adult male aged 30-59 years of 75kg is between PAR 1.4 and 1.5 (mean 1.47 PAL)

[26] *Dietary reference values*, 1991, p.22

[27] Floud *et. al.* (2011). GB and France, Table 2.3, p.69. German male heights read from Figure 5.2 p.230, where adult heights of men in Wurttemberg born in 1868 are around 164 cm and American men read from Figure 6.1 top panel, where men born in 1870 are around 171cm tall on average.

[28] Alter *et. al* (2004) *Stature in Transition*, indicate that adult males aged born in the 1870s were around 166cm tall (Table 5, p.240).

[29] We estimated nutrition using average heights from Floud *et al* (2011) and cohort specific heights using the height data reported in Hatton and Bray (2010) for Europeans and Floud *et al* for USA heights (2011: Ch 6).

adjusted for truncation. Moreover, they relate to young adults and the population is composed of individuals of all ages. Since heights for young men were generally increasing during the second half of the nineteenth century in Europe, the average heights of young men were likely to have been higher than the average of the population as a whole. This implies that the population average energy requirement for men would have been somewhat lower than the energy requirements for young adult men presented here. In the United States, heights in 1890 were recovering from a decline that began around 1830, lasting until the 1890, and thus men born around 1870 were likely to be slightly shorter than the average height of adult males in the population. [30]

We find only minor differences in the distribution of age of head of household across the countries included in the survey, so the comparison between European countries and America is likely somewhat understated in the height data used here because of the different trends in average height in the populations.[31] At various points we use cohort specific heights based on the reported age of the head of household reported in Hatton and Bray (2011), but this does not make a significant difference to our estimates. The energy requirements for adult women and children have been scaled on male requirements, using a modern nutritional equivalence scale, as only piecemeal evidence exists on the heights of women and children at this time.

As Table 4 shows, these differences in adult male height (and implied BMI) make a significant difference to estimates of energy per day needed to satisfy basal metabolism compared with a modern 75kg, 175cm, adult male. For moderately active individuals in 1890 with PAL 1.47, kcal per day vary from a little over 2,300 kcal per day for American adult males to just over 2,000 kcal for Germans. But of course, most of these men worked in physically demanding jobs for long hours and following Fogel, they would need energy to satisfy a PAL of around 2.12 to sustain 10 hours of heavy work a day. Here the variation is from 3,509 kcal/day for American adult men to 3,078 for German men, reflecting the differences in average BMI by country.

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[30] Floud et al (2011) p.331, Table 6.10

[31] There were also minor variations in the average age of head of household by country, though not sufficient to seriously distort the results presented here. Mean age of head of household recorded in the USCL sample was: 42.9 Belgium, 40.3 France, 39.2 UK, 40.5 Germany and 39.3 USA.

<<<INSERT TABLE 4>>>

We have also been able to classify the 1890/91 survey based on the physical activity of the male head of household, as the original returns for the survey record head of household's occupation. All professional and clerical occupations have been classified as 'light', and all industrial occupations as 'heavy', with PALs of 1.47 and 2.12 respectively.[32] All adult females, who were not in paid work, have been treated as undertaking 'moderate' physical activity, with a PAL of 1.8 reflecting the (assumed) energy required for domestic work, and we have adjusted adolescents and younger children's energy requirements for likely lower body weight, using the equivalence scale given in Table 5, taken from the COMA 1991 recommendations. For all women, and youths and children in paid work, we have referenced their energy needs on the kcal per day for 'heavy work'.

<<<<INSERT TABLE 5>>>>>

Turning now to the use of household budget data to derive estimates of nutritional intakes, there are a number of issues that must be addressed. Some of these are generic and others are specific to the USCL enquiry. The USCL survey reports food expenditures and quantities purchased over an unknown period of time. Although ostensibly reported as annual data, it is likely that the reporting period was significantly shorter – possibly just one week, as the reported totals are often multiples of 52. Records of weekly expenditures are likely to display higher variance than those collected over a longer period, and this would be particularly problematic if there was evidence that household budgets for one country were collected over a different time period. Moreover, as is typically the case with expenditure rather than dedicated nutritional surveys, no information is available on the existing household stock of food at the beginning of the reporting period, or how much of the purchased items remained unconsumed at the end. For the US households it is known whether they kept livestock and whether they had a garden, but it is not known how much

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[32] It could be argued that professional and clerical occupations should be classified as 'moderate work', with accordingly higher PALs, because the energy required for work represents only one part of an individual's energy needs, and these non-paid work energy needs in 1890 was likely quite demanding. This judgment reflects energy required keeping warm in winter in houses that were inadequately heated, plus the energy needed to engage self-provisioning, walking to work, household chores, leisure activities etc. There are so few occupations in these categories, that revisions to the PAL applied are unlikely to substantially alter the results.

food was self-produced during the reporting period. In the case of the European households, there is no information on self-resourcing included in the published reports. None of the household budgets include details of food consumed away from the home or food given as gifts, though at this time, both probably represented a very small proportion of total food consumption.

Sometimes the description of the food purchased is vague in nutritional terms. This is particularly problematic in the case of meats, where the nutritional value varies by cut depending upon the proportion of waste and fat. We have utilised McCance and Widdowson's food composition tables, which incorporate quite high 20th century wastage assumptions. In the case of some cuts of meat, only 50-70% is available for consumption, depending upon the meat type and cut. In consequence, an average of several different cuts have been aggregated for each food type (such as beef or pork) including fatty cuts and some of those sold on the bone. The aggregate food waste proportion has been used to deflate our estimates of available nutrition from each food type. It seems likely that less was wasted in late 19th century households than in late 20th century households, so the use of McCance and Widdowson's waste assumptions probably imparts a downward bias to the estimates of energy and nutrient availability. Full details are given in Appendix A2.

There are also other specific problems arising from the idiosyncrasies of the USCL survey. Recall that the *Reports* are fixed format with expenditure recorded for 21 foods. For 11 of these, quantity purchased is also normally recorded leaving 10 food items where the implicit quantities purchased have to be estimated by deflating expenditure by consumer prices. The foods with missing quantities include several key items of consumption, (such as milk, flour, bread, cheese, fresh vegetables, and fresh fruit). The prices for these 10 food items have been carefully matched from a variety of sources.[33] Only in the case of the USA

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[33] **United States of America:** *Eighteenth Annual Report of the Commissioner of Labor: Cost of Living and Retail Prices of Food* (Washington D.C, 1904); Aldrich Report (1893). **United Kingdom:** House of Commons Parliamentary Papers (321). *Report on wholesale and retail prices in the United Kingdom in 1902, with comparative statistical tables for a series of years* (London: H.M.S.O., 1903); Aldrich Report (1893); A. R. Prest, *Consumer's Expenditure in the United Kingdom 1900-1919* (Cambridge: C.U.P., 1954). **Germany:** Franz Eulenburg, *Kosten der Lebenshaltung in deutschen Grossstadten*, (3 vols.). (Munchen und Leipzig: Verlag von Dunder & Humbolt, 1914-15). **Belgium :**Ministere de l'Agriculture, de l'industrie, et des Travaux publics, *Salaires et budgets ouvriers en Belgique au mois d'avril 1891* (Bruxelles, 1891) ; Fritz Michotte, 'L'évolution des prix de détail en Belgique de 1830 à 1913', *Bulletin de l'Institut des Sciences Économiques*, No. 3 (Mai 1937), pp345-

budgets is there any regional information recorded, and then only at the aggregate level of the state of residence. The consumer prices used here reflect the average of a number of towns within each state, for each year of the survey. Some sensitivity analysis was undertaken using the implicit prices for items included in the USCL survey (where quantity and expenditure were recorded) and consumer prices taken from the sources used to estimate quantities where only expenditure information was recorded. Generally, the in-survey prices were a little lower than consumer prices, implying a slight downward bias to the implicit quantity estimates for other foods.[34]

We present measures of household energy adequacy aggregated from recommendations based on the needs of individuals. These needs vary by age, sex and levels of physical activity. As budget surveys rarely provide evidence on the distribution of food within the household,[35] it is obviously possible for some individuals to have inadequate diets in households that seemingly have sufficient energy to meet the needs of all members.

Section 3: Estimates of household energy availability.

Table 6 provides raw unadjusted estimates of per capita energy availability from the foods purchased in the survey across five countries, including energy derived from alcohol. These estimates take no account of differences in industrial coverage between countries, or the skill mix of occupations within industries. The energy derived from recorded expenditures on alcohol seems low, and it is likely that alcohol consumption is under-recorded in this survey.[36] These estimates for the UK are similar to the author's previous estimates derived from this source,[37] though the energy per capita estimates for the UK and USA are

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357. **France:** Jeanne Singer-Kérel, *Le coût de la vie à Paris de 1840 à 1954,* (Paris: Librarie Armand Colin, 1961).

[34] For the USA, two sets of prices are available for 1890, due to Aldrich 1893 and the USCL Report of 1903. We used both sets, but only report the results using Aldrich prices, which gave slightly more comprehensive coverage. Moreover, the differences in estimates of food quantity for US households, based on deflating expenditures by prices from these two sources, are not large.

[35] We also have no information about breastfeeding, which increases the energy requirements of the mother.

[36] Estimates of average energy per capita derived from alcohol, as recorded in the survey, are UK 32 kcal, USA 37 kcal, Germany 41 kcal, France 75 kcal and Belgium 85 kcal.

[37] The figures for the UK of 2227 kcal/day with alcohol (using Haines' extraction of the data, Aldrich UK retail prices McCance & Widdowson nutrient conversions) is in line with Gazeley (1985) who estimated an average per capita energy availability of 2227 kcal/day (using Gazeley's extraction of data, retail prices reported in House of Commons papers HC.321 (1903) and McCance & Widdowson nutrient

significantly greater than Logan’s (2009) figures of around 1400 kcal/day for the UK and 1600 kcal/day for the USA. Gazeley and Newell (2015) explain why they find Logan’s estimates implausible.

<<<INSERT TABLE 6>>>>

The country averages presented in Table 6 conceal significant differences by occupation and industry within country, as Tables 7 and 8 reveal, but without too much systematic variation across countries. White-collar workers are only present in the UK and USA, and in the UK they are consuming fewer calories than their blue-collar peers. Generally, within country, households with a head working in coal mining consume more calories than most other industries, though Germany is an exception to this statement.

<<< INSERT TABLES 7 AND 8 >>>

The results reported in Tables 7 and 8 underline the potential importance of the influence of variations in the nature of the national samples on any international comparison. We attempt to adjust for differences in the occupational and industry mix across countries through 5-Nearest Neighbour Matching techniques described in appendix A1 and these results are reported in Table 9. Notice that on matched scores, the per capita energy availability deficit between all European households and those in the USA is slightly greater than the raw means suggest (-377 kcal per capita/day (Table 6) versus -401 kcal per capita/day (Table 9)). However, the deficit with matching for individual European countries moves in different directions, reflecting the idiosyncratic nature of the national samples. Relative to the USA, the deficit for Belgium and GB worsens, but for France and, particularly for, Germany it improves. Overall, these national changes all but wash out in the calculation of the average for all European countries, but the best estimate we have for the inherent national differences in the energy available from national diets, controlling as far as we are able for differences in the samples for each country, is that the average industrial worker’s household in Britain had available around 267 kcal per capita/day less

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conversions) and Gazeley and Newell’s (2015) range of 1843-2245 kcal/day (using Haines’ or Gazeley’s extraction of the data and various combinations of Nutribase or McCance & Widdowson nutrient conversions and Aldrich UK prices or HC.321 prices).

than the average industrial worker's household in the USA. For Belgium the figure is around 478 kcal per capita/day less than similar households in the USA, for France the deficit was 650 kcal per capita/day and Germany around 633 kcal per capita/day. The overall effect is to somewhat level up European household energy availability in per capita terms. While the results differ in detail, they are not so different as to suggest that a raw comparison is completely misleading. As a consequence, and to simplify the text, we report raw unmatched comparisons for the remainder of the analysis with matched comparisons reported in Appendix A1.

<<<<<INSERT TABLE 9>>>>

We now move away from considering per capita estimates of energy availability, which treats the needs of adults and children the same, to an examination of per equivalent adult estimates, where the needs of adults and children differ. In Table 10, we report raw unadjusted international comparisons that utilise the equivalence scale from the UK 1991 energy recommendations reported in Table 5. The move from raw per capita to raw equivalent adult increases the estimate of available energy in the diets for all countries, as young children are now being counted at a fraction of an adult rather than the same as an adult (compare Table 6 with Table 10). For the USA, the move from per capita to per equivalent adult raises the estimate of average energy availability from just over 2,400 to just over 3,000 kcal per day. Per equivalent adult, Belgium households have on average just over 2,600 and British households just fewer than 2,800 kcal per day. The figures for France and Germany are much lower at around 2,100 kcal per day respectively. Table 10 also reports these figures in terms of country gaps compared with the USA, with the largest gap found among German household who have available just under 1,000 kcal per equivalent adult per day less than the average of those households in the survey from the USA. The overall conclusion of the analysis reported in Table 10 is that the average European late nineteenth century industrial workers' household received about 500 fewer calories per equivalent adult than their American counterparts.

<<<<INSERT TABLE 10>>>>

Of course, as was the case with the per capita estimates discussed earlier, these raw per adult equivalent figures are based upon the comparison of samples covering different industries and skill composition. Table A1/1 reports matched values per equivalent adult per day by country, using a method identical to that used to generate the matched per capita estimates reported in Table 9. The overall result of about a 500 calorie per day per equivalent adult shortfall between European and American industrial workers remains the same, despite differences in detail.

Section 4. Energy availability relative to requirements.

The question remains whether the available energy gap between American and European households persists given the differences in heights and stature across countries. As we established in Section 3, American adult males were on average likely to be about 3 cm taller than British adult males, who in turn were taller than other Europeans. Fewer calories were necessary to sustain shorter Europeans than American at the same Physical Activity Level. However, because we have the age of the Head of Household, we are also able to calculate the likely cohort specific heights from Hatton and Bray (2011) for European men and Floud *et al's* (2011) series of heights by birth cohort for Americans.[38] Moreover, we have seen that the USCL sample had vastly different coverage of occupations and industries by country. There were also systematic differences by country in the proportion of women and children working. All of these factors will influence the energy requirements of the household, via their assumed physical activity levels.

We have calculated the energy requirements of each household on the assumption that adult males working in manual work required a PAL of 2.12. Similarly, the energy requirements of adult women and children who were working were calculated using the same physical activity rates. Adult women who were not in paid work, would not have the same very high average energy requirements, but were still likely to require more energy than adult men in white-collar occupations. Women not in paid work were assumed to require a PAL of 1.8 and adult men and non-working children were all assumed to require a PAL of 1.47. The

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[38] The cohort specific heights are derived from Hatton and Bray (2011). The US cohort specific heights derive from Floud *et al* (2011) Chapter 6.

vast proportion of adult men in this survey were working in energy demanding blue-collar work. This is true for all countries, but as Table 8 reveals, there were a number working in professional occupations in Britain and America, and we have taken account of their lower physical activity rates by adjusting the energy these individuals needed. Of course, these white collar heads of households may have had wives in paid work or children working and this participation in the labour market is reflected in the assumptions we have made regarding their individual physical activity rates.

We have elsewhere attempted to justify similar assumptions with respect to British households at the turn of the twentieth century, breaking down activities across a 24-hour period (Gazeley and Newell 2015). The use of a factorial approach to estimating PAL is consistent with the methodology adopted in FAO/WHO 1985 and COMA 1991. With respect to the USCL data, we have carried out some sensitivity tests with respect to these assumptions, particularly the assumptions surrounding the needs of children working and how these should be treated if their gender and age are not known, and what their energy requirements should be if working, where their industry and occupation is unknown. The results are sensitive to the assumptions adopted here, but not significantly so and whatever assumptions we make the broad judgements we arrive at with regard to the adequacy of diets by country remain unchanged. [39]

<<<<INSERT TABLE 11>>>

Table 11 reports the raw unadjusted results of calculating the average energy availability relative to energy requirements based on the assumptions described above, based upon COMA 1991 energy requirements. A figure of 1.00 indicates that on average, available energy was sufficient to sustain the household given the likely BMI and physical activity rates of its members. Notice that Table 11 indicates that on average both British and American households had a small surplus of available calories relative to their

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[39] For example, we know if the household includes one or more children working, but the survey reports do not indicate which child is working. We have experimented with a number of approaches to this issue, including: assumptions relating to the age order of children and work, priority for male children over 12, assumption of work in head of household’s industry etc. All of these assumptions affect the detail of the results. Here we report in Table 12 through 14 the simplest set of assumptions we adopted, which are that working children are solely chosen by age, with no preference for gender or industry/occupation of parents.

requirements, *once we take account of the smaller average physical stature of the British households*. Belgian households had a small deficit, but both German and French households had diets that on average met only 70-80 per cent of their needs, even allowing for their smaller stature. A matched version of Table 11 is reported as Appendix A1/2.

The assumption of shorter European heights in Tables 11, and hence lower BMI and calorie requirements for the same PAL, transform the position of UK 1890 households from one where energy availability is not quite sufficient to meet the requirement of sustained physical work for 10 hours a day, to a one where on average these requirements are met with a small surplus. Similarly, the position of Belgium, German and French households is also improved, once due account is taken for their smaller stature. Though the energy available to households in all three continental European countries remains below that required for sustained physical work (assuming an optimal distribution of calories within the family). In France and Germany this estimated energy deficit is still considerable at around 20-25% of requirements. Overall, it is striking how close these results are to the Flood *et al's* estimates quoted in the introduction to this article.

Because of concerns relating to the overestimation of BMR in the COMA 1991 standard outlined in Section 3, we repeat these calculations replacing the COMA 1991 standard of adequacy with estimates of BMR derived from US Institute of Medicine 2005. These are reported in Table 12 (and Table A1/3 for a matched version) and are identical in all other respects to Tables 11 (and Table A1/2). The consequence of this procedure is to generally lower energy requirements and hence raise the measured performance of households against the chosen nutritional standard, as can be seen by the higher mean country and mean USA estimates in Tables 12. Because the performance of US households has improves, the affect on the European-USA comparison is to worsen the relative position of households in most European countries, but not by much. The substitution of the 2005 BMR estimates do not materially affect the conclusions we reached on the basis of applying the COMA 1991 standard without modification.

<<<<<INSERT TABLE 12 >>>>>

Section 5: Welfare gains from migration.

The United States population census records a stock of 2.78m native born Germans, and 1.25m native born British in 1890.[40] These substantial expatriate groups were the result of substantial flows of emigrants from Europe to the United States during the nineteenth century. Hatton and Williamson (1998) quote decadal average gross emigration rates per 1,000 of population as 2.18 for Germany and 5.71 for Great Britain.[41] This emigration from the old to new world was composed increasingly of young adult males.[42] According to Bade (2008), 60-70% of British migrants and 90% of German headed to the US in the last quarter of the nineteenth century, reaching a peak in 1880-1893 when 1.8m Germans emigrated to the US.[43] Between 1886 and 1890 the yearly average emigration of Europeans was 779,000, most of whom headed for the US, though return migration was volatile and varied by country, and reached a peak of 60% in the 1890s for British migrants.[44]

Hatton and Williamson (2005) show that the welfare gains from migration were potentially large, as the average British wage was around 60% of the US wage in 1870. In the 1890 survey, average British household income per capita was 80% of US household per capita, with other European households on average around 50% of the US level (as Table 1 makes clear). These intercontinental relative wage differentials acted as one of the key determinants of migration flows.[45] The USCL survey includes details of the ethnicity of the head of household for the American budgets, so it is also possible to make direct comparison between European households in Europe and ethnic Europeans living in the US. The welfare gains to emigration can be seen from the comparison set out in Table 13, which records income of households in Europe compared with the same ethnicities in the USA. The largest gains were for Germans, followed by the French and then the British. Even in the latter case the difference in income per capita between households in the UK and ethnic British household in the USA was substantial.

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[40] Plus 22,000 native born Belgians and 107,000 native born French.

[41] Hatton and Williamson (1998) *The Age of Mass Migration: Causes and Economic Impact*, Table 3.1 p.33

[42] Hatton (2001) The age of mass migration: what we can and can't explain, p.2

[43] Bade (2008) *Migration in European History*, pp.104-6

[44] Bade (2008) p.98 and p.104

[45] Hatton, T.J. and J.G. Williamson (2005) *Global Migration and the World Economy: Two Centuries of Policy and Performance*. Cambridge. p.55

<<<<INSERT TABLE 13>>>>

It seems reasonable also to posit that poverty and hunger at home acted as a stimulus to migration and we have examined already the differences in the energy available from diets in Europe and America. Migration from Europe to the US eliminates any energy deficiency evident in European diets. The average nutritional status (defined as household energy availability relative to the COMA standard) improves from 0.929 to 1.314 for Belgian households, from 0.788 to 1.067 for French households, from 0.740 to 1.015 for German households and from 1.049 to 1.050 for British households (see Table 11 compared with Table 14). But these comparisons understate the welfare gain because they assume that the ethnic Europeans in the US are taller than their European counterparts. Given the likelihood that migration was of primarily of mature adults, ethnic Europeans in the US were probably shorter than those US heads of households defining themselves as “American”.

<<<<<INSERT TABLE 14>>>>>

The Kernel Density plots in Fig 1 and 2, demonstrate the subtle changes caused by differing height assumptions, and their effects upon the performance of households relative to the COMA 1991 recommendations. Note that in Fig 1, with the assumption of common heights in the USA, households are much more compactly distributed. Indeed the USA and `British' and German households are nearly indistinguishable. However, once the requirements are readjusted to take account of differing heights according to ethnicity within the USA, then the distributions subtly shift. American only households do not shift their position, but as expected there is differential creep for each distribution towards the right hand side. That is, each ethnic group is actually doing much better in the US than in Europe.

<<<<INSERT FIG 1 AND FIG 2 >>>>>>

Changing the height requirement for each nationality not only creeps the distribution to the right, but also diminishes the density around meeting the requirement, but this density is now distributed more along the 1+ requirement. A good example of this phenomenon is the German distribution, where it can be seen from Fig 2 that the peak of the distribution diminishes and the distribution also `flattens'. The `British' households are systematically much better fed than the average American household. Heights do not seem to affect the composition or density of points below requirement and in the extreme left tail. Indeed the distributions remain largely the same.

Of course, these calculations also imply that our assumption that Americans were on average taller than their European counterparts is likely incorrect for those Americans in the sample that define themselves as ethnic European, and were first generation migrants. If we recalculate estimates of American energy availability relative to needs assuming ethnic Europeans in the US have the same heights as they did in Europe, unsurprisingly this assumption improves the nutritional status of American households relative to their European peers, but it does not alter the broad conclusions we have drawn from this analysis, as the US and British households remain roughly comparable in terms of energy availability relative to needs, despite a significant gap in income between US and British households.

Finally we ask if these data reveal anything about intergenerational nutrition and welfare? We know that more energy was consumed by the US-based respondents, but what about the treatment of children? Do those higher-income US households feed their children better? If so, then we have found evidence supportive of a more rapid growth trajectory for average bodily stature.

In Table 15 we report the impact, or, more accurately the partial correlations of the presence of children in different age bands with adult-equivalent calorie availability. The equation estimated is:

$$\begin{aligned}\log calories\ per\ head \\ &= \alpha_1 \log income\ per\ head + controls\ for\ childrens\ age \\ &+ controls\ for\ industry\ of\ head + error\ term.\end{aligned}$$

We perform this regression for the whole US sample, for those in the US of British nationality and finally for the British households in Britain. We include industry controls in all regressions. In each cell we report the coefficient associated with the number of children in the various age groups.

To read the results accurately, take the impact of children aged less than two years in the USA sample in the top left corner. Our regression estimate is that, controlling for income and industry, replacing an average family member with a child under two years of age reduces calories per head by 7.7 log points. Given the lower energy requirements of babies, this result is as expected. Note also how these reductions fall in size as age is increased, again as expected. Looking across the columns, the most useful comparison is between British households based in the USA and the UK-based households. There we find almost identical coefficients for babies under two and for children between five and nine years old, but smaller coefficients for children aged two to four and for teenagers.

We conclude this evidence suggests that, compared to their counterparts in Britain, British industrial workers in the USA did not feed their children any worse, relative to adults, and may well have fed them relatively better. A reasonable prediction from this is that higher incomes in the USA lead to higher levels of calorie availability for children and thus would lead to more rapid increases in stature.

Conclusions.

We find that American household diets had more energy available measured per capita or per equivalent adult than their European counterparts. On average this figure was around 500 calories per day per equivalent adult. But for all countries our estimates of energy availability are significantly below the figures cited by Floud *et al* derived from production data. Across Europe, there were wide calorie gaps, with British and Belgian workers' households were much closer to US levels than their French and German counterparts.

This paper also reports the first attempt to estimate differences in energy availability relative to energy requirements that take account of differences in physical stature, physical activity levels, sex and age. Taking these factors into account, we find that superior American dietary energy over all European countries measured in per capita or per equivalent adult terms is partly over-turned. British households on average had at least the same energy availability relative to requirements as their American peers, though the gap between American households and other European households was still pronounced. In terms of Fogel's thesis, we find that on average, once due account is taken of likely differences in stature, both British and American households had diets supplying sufficient energy to sustain 10 hours a day of hard physical labour. This was not the case for households in other European countries at this time.

It might be expected, other things being equal, that these differences in energy availability relative to needs across countries would influence labour productivity. Only aggregate data exists for 1890, and not for all countries, but Broadberry (1997) indicates that labour productivity in the US was roughly double that in the UK, which in turn was roughly equivalent to German levels.[46] In view of the rough correspondence of energy availability relative to needs that we find for the UK and USA, once differences in stature have been adjusted for, and the superior energy availability relative to needs of UK households compared to German households, this rank ordering in labour productivity estimates is perhaps somewhat surprising. Though, of course, measured productivity is the outcome of a multitude of factors unrelated to the nutritional status of labour.

Finally, we investigate the welfare gains in nutritional terms of emigration from continental European countries, where on average households are unable to satisfy the energy required for sustained physical work, to the US. We find that all European ethnic groups in the US have relatively energy-rich diets and that once the likely differences in physical stature are taken into account, the escape from hunger through intercontinental migration is all the more evident. We also show that British migrants to the US are at least as generous in providing calories for the children as their counterparts in Britain, with the implication that the children of these migrants would, on average, grow more.

Thus, industrial workers in the US were ahead of their European counterparts in the race to escape hunger. But their brothers and sisters in Europe were getting close to ending hunger, and soon would. For Europe, these were some of labour's aristocrats, and it would be longer before the escape was complete for the whole of their populations. Clearly, escaping from hunger has more than one meaning for European migrants close to the breadline in the closing decades of the twentieth century.

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[46] Broadberry (1997), *The Productivity Race,* p.2 fig 1.1

Table 1: USCL Household Income & Composition 1889/90 (annual US $)

	Mean Household Size	Mean Total HH Income	Mean Husband's Income	Mean Total HH Expenditure	Mean Total HH Expenditure per capita
USA	5.19	686	529	619	135
UK	5.01	534	398	488	107
Germany	5.66	305	218	300	58
Belgium	5.57	421	271	388	77
France	5.04	411	274	370	81

Authors' calculations from USCL survey data

Table 2: USCL Women & Children’s income 1889/90 (income in annual US $)

	Mean Husband’s Income $	Mean Wife’s Income $	Mean Children’s Income $	No. HH with Women Working (proportion)	No. HH with Children Working (proportion)
USA	529	13	122	470 (0.07)	1979 (0.29)
UK	398	11	125	60 (0.06)	424 (0.41)
Germany	218	8	59	19 (0.09)	65 (0.34)
Belgium	271	2	147	1 (<0.01)	63 (0.51)
France	274	30	129	82 (0.25)	144 (0.43)

Authors’ calculations from USCL survey data

Table 3: The Relative Cost of Food

	US Basket	Belgian Basket	French Basket	German Basket	UK Basket
US prices	100	161	167	160	123
Belgian prices	63	100	88	95	86
French prices	74	125	100	129	103
German prices	68	112	87	100	93
UK prices	75	140	140	126	100

Authors’ calculations from USCL survey data

Table 4: Heights of adult males reaching maturity in 1890, and estimates of energy requirements assuming a PAL of 2.12

	Average adult male height (cm)	Average adult male weight (kg)	Average adult male BMI	Estimated kcal/d required for BMR	Estimated kcal/d required for PAL 1.47	Estimated kcal/d required for PAL 1.80	Estimated kcal/d required for PAL 2.12
USA	171	63.88	21.96	1,656	2,434	2,981	3,509
UK*	168	58.69	20.79	1,577	2,318	2,839	3,343
Belgium**	166	55.86	20.05	1,528	2,246	2,750	3,239
France	165	53.86	19.16	1,503	2,209	2,705	3,186
Germany	164	50.49	18.88	1,452	2,134	2,614	3,078

Source: Column I-IV, Floud *et al* 2011, p.73, Table 2.6, Columns V, VI and VII, calculated as Column IV x 1.47, 1.8 and 2.12 respectively

* calculated from average of 167 and 169 cm, Floud *et al* 2011, p.73, Table 2.6

** Alter et al 2004, p.240, Table 5. Average height of male recruits age 20 born in the 1870s (average of Limbourg, Tilleur and Verviers), rounded to nearest cm. Weight and BMI estimated from average for 165cm and 167cm given in Floud et al, Table 2.6

Table 5: Energy equivalence scale

Males		Females	
Men 30-59	1.00	Women 30-59	0.75
Men 19-29	1.00	Women 19-29	0.76
Boys 15-18	1.08	Girls 15-18	0.83
Boys 11-14	0.87	Girls 11-14	0.72
Boys 7-10	0.77	Girls 7-10	0.68
Boys 4-6	0.67	Girls 4-6	0.61
Boys 1-3	0.48	Girls 1-3	0.46
Boys <1 (6 months)	0.27	Girls <1 (6 months)	0.25

Calculated from Department of Health, UK Dietary Reference values (1991), Table 1.1, where adult men require 2, 550 kcal/d. This corresponds to a PAL of around 1.47, assuming a mean weight of 75kg and kcal/d for BMR of 1,735 (where BMR = 11.5W+873, for men 30-59 years, from Table A1, p.198 and Annex 2 p.202).

All adult men have been assumed to require PAL 2.12, except the relatively small number in professional and clerical occupations where PAL 1.47 has been used. Women's requirements have been scaled on adult men with a PAL 1.8, unless in paid work, where a PAL of 2.12 has been used. All boarders have been treated as requiring PAL 1.47. Where the child's sex is unknown and average equivalence has been used, by age. Children in paid work have been scaled on PAL 2.12, otherwise on PAL 1.47.

Note that the formula given in Department of Health (1991) gives estimates of kcal/d for BMR that are around 50 kcal/d lower than the figures given in Floud et al (2011) Table 2.6.

Table 6: Raw mean energy per capita relative to the USA

	Mean Difference	Mean Country	Mean USA
Belgium–USA	-285	2,134	2,419
	(77)	(77)	(10)
N	6,820	122	6,698
France–USA	-690	1,728	2,419
	(43)	(42)	(10)
N	7,029	331	6,698
GB–USA	-192	2,227	2,419
	(23)	(21)	(10)
N	7,712	1,014	6,698
Germany–USA	-860	1,559	2,419
	(33)	(32)	(10)
N	6,896	198	6,698
Europe–USA	-377	2,042	2,419
	(20)	(18)	(10)
N	8,363	1,665	6,698

***, **, * denote statistical significance at the 1%, 5% and 10%, respectively. Average Treatment Effect is reported in the first column, this has been estimated with the technique as title. Mean for USA should be considered the ‘counterfactual mean’, or the adjusted mean. Standard errors reported in parentheses.

Table 7: Mean calories per capita by country and occupation

	Belgium	France	GB	Germany	USA
Unskilled	2,119.80	1,673.07	2,159.46	1,577.38	2,338.68
	(167.47)	(98.31)	(43.29)	(79.80)	(16.88)
N	22.00	79.00	245.00	31.00	2,009.00
Semi-Skilled	2,057.96	1,560.59	2,231.60	1,552.30	2,449.94
	(116.72)	(66.91)	(35.31)	(81.59)	(22.22)
N	26.00	73.00	332.00	42.00	1,320.00
Skilled	2,175.20	1,840.61	2,252.96	1,534.45	2,473.73
	(132.32)	(78.31)	(43.29)	(42.76)	(18.07)
N	52.00	83.00	264.00	95.00	2,073.00
Craftsman	2,187.16	1,864.22	2,322.12	1,598.52	2,445.99
	(237.34)	(97.46)	(53.68)	(74.58)	(29.71)
N	18.00	72.00	125.00	24.00	745.00
White collar			2,121.98		2,482.57
			(170.94)		(66.42)
N	1.00	3.00	11.00	1.00	112.00
Apprentices			2,140.93		2,359.30
			(104.46)		(62.14)
N	3.00	0.00	35.00	1.00	200.00
Other		1,490.95			2,373.86
		(123.22)			(48.50)
N	0.00	21.00	2.00	4.00	239.00

***, **, * denote statistical significance at the 1%, 5% and 10%, respectively. Means for cell sizes with fewer than 10 observations have been suppressed. Standard errors reported in parentheses

Table 8: Mean calories per capita by country and industry

	Belgium	France	GB	Germany	USA
Pig Iron	2,044.09		1,850.20		2,439.99
	(252.27)		(57.93)		(34.68)
N	11.00	0.00	65.00	0.00	708.00
Bar Iron	1,889.49	2,139.66	1,901.66	1,526.18	2,469.89
	(92.78)	(138.30)	(53.69)	(78.93)	(36.92)
N	73.00	40.00	109.00	22.00	595.00
Steel			2,231.50	1,538.28	2,309.97
			(58.63)	(77.02)	(58.39)
N	0.00	0.00	162.00	35.00	175.00
Coal	3,036.90		2,279.80	1,485.38	2,441.73
	(197.54)		(45.94)	(105.62)	(36.96)
N	10.00	0.00	166.00	18.00	505.00
Coke			2,563.27	1,659.71	2,333.14
			(157.90)	(153.42)	(50.38)
N	4.00	0.00	14.00	10.00	249.00
Iron Ore				1,452.68	2,155.01
				(75.02)	(56.05)
N	0.00	0.00	0.00	19.00	165.00
Cotton		1,673.96	2,392.80	1,589.62	2,310.01
		(56.80)	(37.15)	(56.19)	(14.67)
N	0.00	114.00	341.00	71.00	2,124.00
Wool		1,670.58	2,110.76	1,626.35	2,324.69
		(59.58)	(44.49)	(102.62)	(24.04)
N	0.00	177.00	131.00	23.00	907.00
Glass	2,572.32		2,397.18		2,688.19
	(156.66)		(150.36)		(23.64)
N	24.00	0.00	26.00	0.00	1,270.00

***, **, * denote statistical significance at the 1%, 5% and 10%, respectively. Means for cell sizes with fewer than 10 observations have been suppressed. Standard errors reported in parentheses

Table 9: Matched estimates of energy per capita (5-nearest neighbours matching).

	Mean Difference	Mean Country	Mean USA
Belgium–USA	-478	2,141	2,619
	(88)	(79)	(41)
N	3,409	112	423
France–USA	-650	1,711	2,361
	(51)	(42)	(23)
N	3,578	297	975
GB–USA	-267	2,221	2,488
	(31)	(21)	(17)
N	7,240	991	2,371
Germany–USA	-633	1,553	2,186
	(42)	(32)	(25)
N	4,495	187	705
Europe–USA	-401	2,040	2,441
	(26)	(18)	(14)
N	8,005	1,593	3,259

Average Treatment Effect is reported in the first column, this has been estimated with 5 nearest neighbour matching as outlined in text. Mean for USA should be considered the ‘counterfactual mean’, or the adjusted mean. Abadie Imbens (2008) robust standard errors computed on 14 nearest-neighbours. Matching is done on the basis of industry, occupation, household size, family size, household head’s age, wife’s age and demographic composition of children.

Table 10: Raw estimates of mean calories per equivalent adult

	Mean Difference	Mean Country	Mean USA
Belgium–USA	-425	2,616	3,042
	(90)	(90)	(12)
N	6,820	122	6,698
France–USA	-895	2,147	3,042
	(48)	(47)	(12)
N	7,029	331	6,698
GB–USA	-254	2,788	3,042
	(24)	(22)	(12)
N	7,712	1,014	6,698
Germany–USA	-963	2,078	3,042
	(58)	(57)	(12)
N	6,896	198	6,698
Europe–USA	-478	2,563	3,042
	(23)	(20)	(12)
N	8,363	1,665	6,698

***, **, * denote statistical significance at the 1%, 5% and 10%, respectively. Average Treatment Effect is reported in the first column, this has been estimated with the technique as title. Mean for USA should be considered the ‘counterfactual mean’, or the adjusted mean. Standard errors reported in parentheses

Table 11: Raw mean calories available relative to COMA 1991 requirements (Floud *et al* average heights)

	Mean Difference	Mean Country	Mean USA
Belgium–USA	-0.098	0.929	1.027
	(0.031)	(0.031)	(0.004)
N	6,820	122	6,698
France–USA	-0.239	0.788	1.027
	(0.016)	(0.016)	(0.004)
N	7,029	331	6,698
GB–USA	0.022	1.049	1.027
	(0.008)	(0.007)	(0.004)
N	7,712	1,014	6,698
Germany–USA	-0.286	0.740	1.027
	(0.018)	(0.018)	(0.004)
N	6,896	198	6,698
Europe–USA	-0.075	0.951	1.027
	(0.008)	(0.007)	(0.004)
N	8,363	1,665	6,698

***, **, * denote statistical significance at the 1%, 5% and 10%, respectively. Average Treatment Effect is reported in the first column, this has been estimated with the technique as title. Mean for USA should be considered the 'counterfactual mean', or the adjusted mean. Standard errors reported in parentheses. Working children are solely chosen by age, no preference for gender or industry of parents

Table 12: Raw mean calories relative to COMA 1991 requirements with IMO (2005) DWL BMR and Hatton and Bray cohort specific heights)

	Mean Difference	Mean Country	Mean USA
Belgium–USA	-0.098	1.033	1.131
	(0.035)	(0.035)	(0.004)
N	6,820	122	6,698
France–USA	-0.255	0.876	1.131
	(0.019)	(0.018)	(0.004)
N	7,029	331	6,698
GB–USA	0.027	1.158	1.131
	(0.010)	(0.009)	(0.004)
N	7,712	1,014	6,698
Germany–USA	-0.321	0.810	1.131
	(0.022)	(0.021)	(0.004)
N	6,896	198	6,698
Europe–USA	-0.079	1.051	1.131
	(0.009)	(0.008)	(0.004)
N	8,363	1,665	6,698

Mean difference is reported in the first column. Country specific means are reported in columns 2 and 3. Standard errors reported in parentheses. Working children are solely chosen by age, no preference for gender or industry of parents.

Table 13: Incomes at home and abroad

	Living in US	Living in country of origin
British workers		
Income per capita (mean $ year)	134	107
Number in the household, mean	5.5	5.1
Husband’s age, mean in years	42.5	39.2
Share of husband in household income	0.70	0.75
Share of wife in household income	0.02	0.02
German Workers		
Income per capita (mean $/year)	139	54
Number in the household, mean	5.0	5.7
Husband’s age, mean in years	40.21	40.5
Share of husband in household income	0.86	0.72
Share of wife in household income	0.01	0.03
French workers		
Income per capita (mean $/year)	147	81
Number in the household, mean	5.0	5.0
Husband’s age, mean in years	37.6	40.31
Share of husband in household income	0.77	0.67
Share of wife in household income	0.04	0.08

Table 14: Raw mean calories available relative to COMA 1991requirements for ethnic Americans (Floud *et al* average heights)

	Mean Difference	Mean Ethnic in USA	Mean rest of USA
Belgian	0.416	1.541	1.125
	(0.089)	(0.088)	(0.005)
N	4,760	12	4,748
Franch	0.167	1.292	1.125
	(0.050)	(0.050)	(0.005)
N	4,827	79	4,748
British	0.086	1.210	1.125
	(0.010)	(0.009)	(0.005)
N	5,963	1,215	4,748
German	0.140	1.264	1.125
	(0.016)	(0.015)	(0.005)
N	5,392	644	4,748

***, **, * denote statistical significance at the 1%, 5% and 10%, respectively. Average Treatment Effect is reported in the first column, this has been estimated with the technique as title. Mean for USA should be considered the ‘counterfactual mean’, or the adjusted mean Abadie Imbens (2008) robust standard errors computed on 14 nearest-neighbours. Matching is done on the basis of industry, occupation, household size, family size, household head’s age, wife’s age and demographic composition of children.

Table 15: the impact of family structure on log calories be head among various groups of households in the USCL data.

	USA sample	British workers in the USA	British workers in Britain
Children under 2	–0.077***	-0.078***	-0.080***
Children 2 to 4 years	-0.059***	-0.032**	-0.052***
Children 5 to 9 years	-0.031**	-0.033***	-0.032***
Children 10 to 15 years	-0.006**	0.009	-0.021***
Sample size	6698	921	921

See text for explanation. *** and ** denote conventional significance and the 1 percent and 5 percent levels respectiviely.

FIG 1 Common Heights

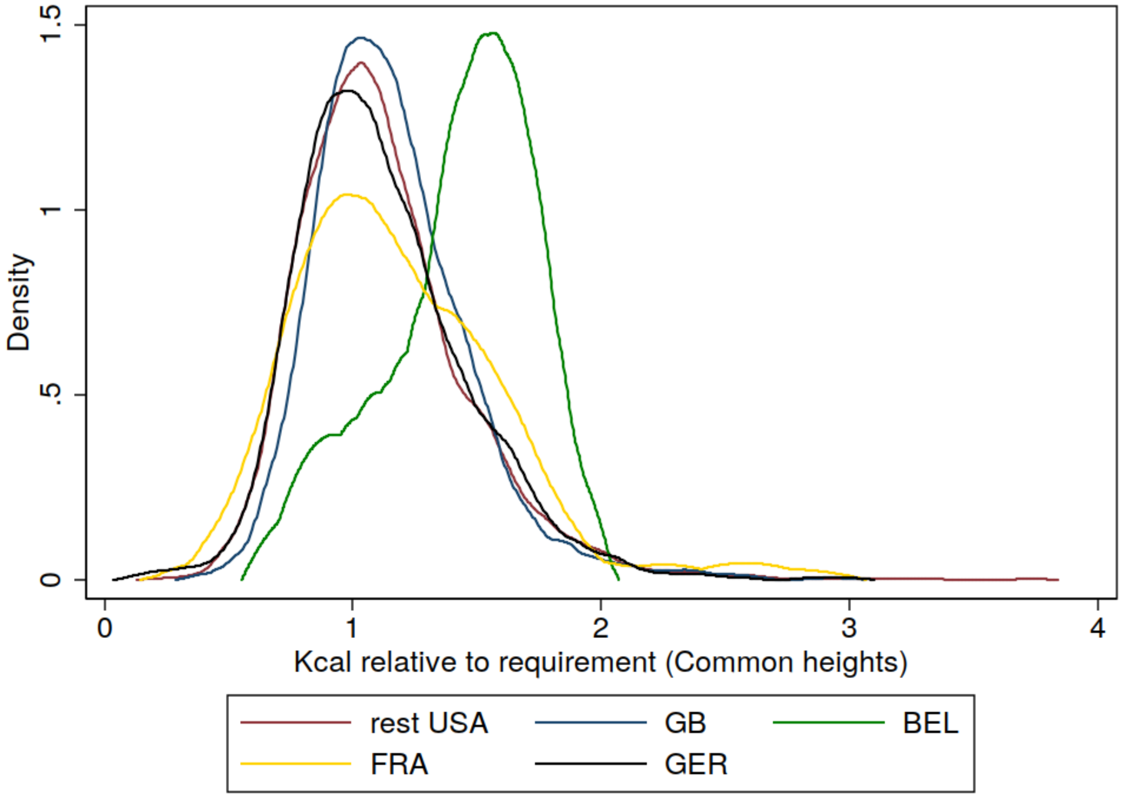
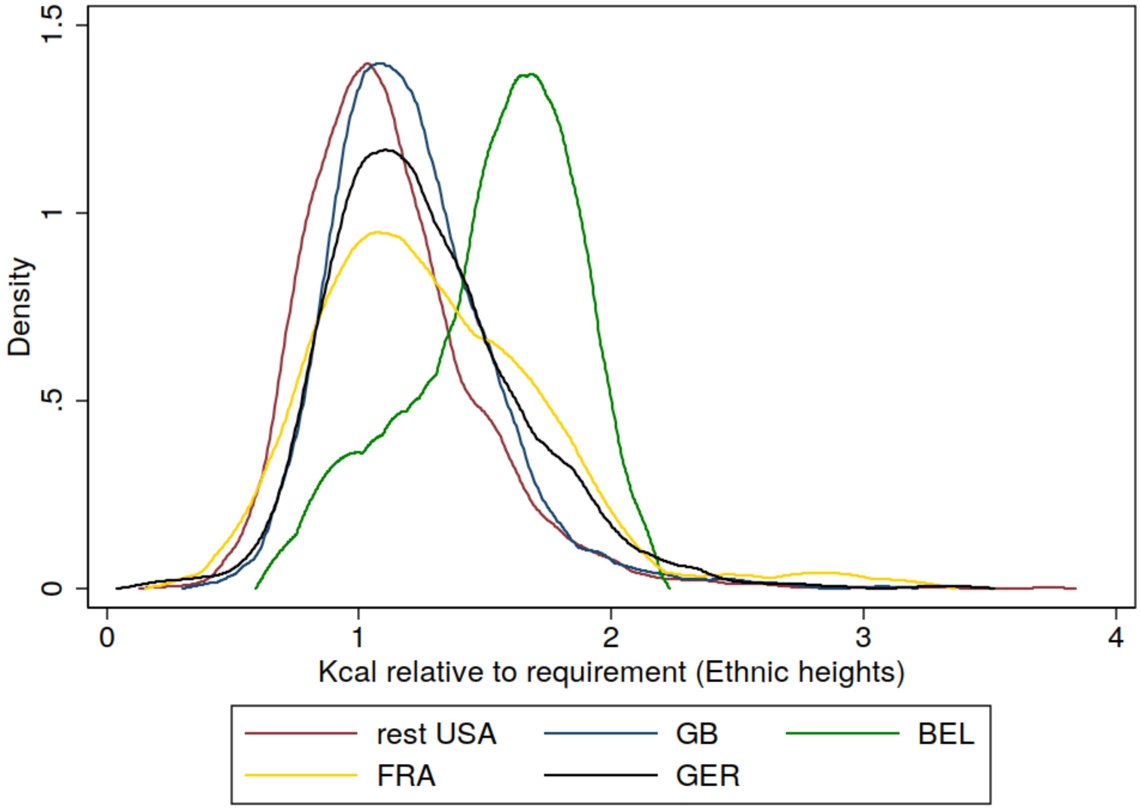


FIG 2 Ethnic Heights



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Appendix A1: Addressing sample bias using propensity matching techniques

It is clear that because of differences in the construction of the national sub-samples in the USCL survey, any comparison across countries is not based on a true like-for-like comparison. Therefore, any differences in estimates of available energy derived from the analysis of the foods purchased by the households could be due to differences in sampling, or variations in the underlying population, rather than international differences in the economic circumstances facing similar households. In order to mitigate this concern, one approach that can be adopted is to apply Propensity Matching techniques. The application of these techniques is straightforward and intuitive. They provide the means by which to compare two sub-populations: those that are `treated' versus those that are `controls'. In a non-experimental setting, matching ensures that comparisons are drawn between similar groups. And assuming selection is on the basis of observable characteristics, Rosenbaum and Rubin (1983) show that if these are conditioned upon, and the same broad categories are being compared, then it is possible to compare across units that are deemed to be similar.

In practise, the application of this technique implies that if we estimate a propensity score regression and match using an algorithm, any mean differentials will be uncorrelated with sampling differentials, as both samples have been ‘matched’ to resemble each other. This technique is employed in a two-step approach. In the first, the probability of belonging to either `treatment' or `control' group, conditional on covariates, is used to estimate the propensity score. In our application we take the following pairwise comparisons: belonging to a given European countries sample (viz. Belgium, France, Great Britain or Germany) versus the American sample, and the combined European versus American sample. We conditioned on the following household characteristics: family size, the presence of boarders, the age of the head of household and his wife, the demographic composition of children within the household (as determined by a series of dummy variables for age and gender), and finally the skill group and industry in which the head of household labours.

From this model we estimate the propensity score, as the central probit index prediction that an observation belongs to the treated group in question. We then apply the Nearest Neighbour Matching algorithm to obtain those observations in the control group (or in our application the American sub-sample) which have the nearest propensity score to each given `treatment' unit or European household. In practice the quality of the match may be problematic and it is possible to trade off between one-to-one matching and many-to-one matching by oversampling control units picked for each treatment unit.[47] We adopt matching on the five

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[47] This lowers the bias from the estimate with the commensurate trade-off of increasing the variance in the estimate (Caliendo and Kopening 2008). Abadie and Imbens (2006) show the standard deviate derived standard errors do not reflect that the estimated mean difference is the result from a matching technique. They derive proximately normal standard errors, and it is these that we report in the tables in the text.

closest nearest neighbours without replacement. Once the data is matched, the usual balancing tests were applied, which ensure that, after the data is matched, the covariates that are used are then statistically indifferent between the European and American surveys. The final stage of this approach is to estimate the mean difference between the matched `treated' and untreated units. Conditional on this technique working, we can say that we have controlled for differences in the samples, and have an estimate of the differences inherent between the two sets of industrial workers.

Table A1/1: Matched mean calories per equivalent adult 5-nearest neighbours matching

	Mean Difference	Mean Country	Mean USA
Belgium–USA	-560	2,648	3,208
	(98)	(92)	(46)
N	3,409	112	423
France–USA	-842	2,170	3,012
	(58)	(47)	(27)
N	3,578	297	975
GB–USA	-322	2,786	3,108
	(34)	(22)	(19)
N	7,240	991	2,371
Germany–USA	-813	2,067	2,880
	(68)	(53)	(35)
N	4,495	187	705
Europe–USA	-488	2,577	3,065
	(29)	(20)	(16)
N	8,005	1,593	3,259

***, **, * denote statistical significance at the 1%, 5% and 10%, respectively. Average Treatment Effect is reported in the first column, this has been estimated with the technique as title. Mean for USA should be considered the ‘counterfactual mean’, or the adjusted mean Abadie Imbens (2008) robust standard errors computed on 14 nearest-neighbour matching is done on the basis of industry, occupation, household size, family size, household head’s age, wife’s age and demographic composition of children.

Table A1/1 reports matched values per equivalent adult per day by country, using a method identical to that used to generate the matched per capita estimates reported in Table 9. The overall result remains the same, despite differences in detail. Comparing the results of matching and estimating raw per equivalent adult energy availability reported in Table 9, the gaps between European households and those in the USA move unevenly: British and Belgian households have fewer calories per day available when matched with households with similar characteristics in the USA, whereas German and French households have available slightly more kcal per day per equivalent adult. However, the comparison of matched households still suggests that there was a significant available energy gap between American and European households (just fewer than 500 kcal per equivalent adult per day).

Table A1/2: Mean Difference in calories relative to COMA 1991 requirements (5-nearest neighbours matching) Floud *et al* average heights

	Mean Difference	Mean Country	Mean USA
Belgium–USA	-0.115	0.946	1.062
	(0.032)	(0.032)	(0.014)
N	3,409	112	423
France–USA	-0.207	0.785	0.992
	(0.019)	(0.016)	(0.008)
N	3,578	297	975
GB–USA	0.029	1.048	1.019
	(0.011)	(0.007)	(0.006)
N	7,240	991	2,371
Germany–USA	-0.245	0.736	0.981
	(0.021)	(0.017)	(0.011)
N	4,495	187	705
Europe–USA	-0.055	0.955	1.010
	(0.009)	(0.007)	(0.005)
N	8,005	1,593	3,259

Average Treatment Effect is reported in the first column, this has been estimated with the technique as title. Working children are assumed by age, no preference for gender or industry of parents. Mean for USA should be considered the 'counterfactual mean', or the adjusted mean Abadie Imbens (2008) robust standard errors computed on 14 nearest-neighbours Matching is done on the basis of industry, occupation, household size, family size, household head's age, wife's age and demographic composition of children..

In Table A1/2 we report the same comparison of energy available relative to household needs, with the same set of assumptions regarding physical activity rates as Table 11, but using propensity score matching. The matched values indicate broadly similar results to the raw comparison. On average both British and American households have diets that meet their energy needs and the continental European households do not.

Table A1/3: Mean Difference in calories relative COMA 1991 requirements with IMO (2005) DWL BMR (5-nearest neighbours matching) Hatton and Bray (2012) cohort specific heights

	Mean Difference	Mean Country	Mean USA
Belgium–USA	-0.132	1.048	1.180
	(0.037)	(0.036)	(0.016)
N	3,409	112	423
France–USA	-0.233	0.873	1.106
	(0.022)	(0.019)	(0.009)
N	3,578	297	975
GB–USA	0.018	1.157	1.139
	(0.013)	(0.009)	(0.007)
N	7,240	991	2,371
Germany–USA	-0.267	0.803	1.071
	(0.025)	(0.020)	(0.012)
N	4,495	187	705
Europe–USA	-0.071	1.055	1.125
	(0.011)	(0.008)	(0.006)
N	8,005	1,593	3,259

Average Treatment Effect is reported in the first column, this has been estimated with the technique as title. Working children are assumed by age, no preference for gender or industry of parents. Mean for USA should be considered the 'counterfactual mean', or the adjusted mean Abadie Imbens (2008) robust standard errors computed on 14 nearest-neighbours. Matching is done on the basis of industry, occupation, household size, family size, household head's age, wife's age and demographic composition of children.

In Table A1/3 we report the matched values of the comparison reported in Table 12

Appendix 2 – Kcal values with Edible Proportions

In the table below, there are simple entries sourced from McCance & Widdowson and composites of such items that we have created. An example of the latter is ‘Peaches Composite’ which is an unweighted average of ‘Peaches, fresh, raw’ and ‘Peaches canned’ that result in 0.935 Kcal per 100g (rounded to 0.94 above, but not in our calculations). We have also created more complex composites (composites of composites) where we have deemed this to be appropriate. ‘Fruit composite’, for example, utilises ‘Peaches composite’, other composites, and simple entries. The most complex examples are the ‘Beef, Veal and Offal’ composites created for each of the five countries examined. With different weightings, these take some account of the differences in consumption between countries (see details in the ‘Notes’ column). Unless otherwise stated in the notes, composites comprise unweighted means of their elements.

Item	**Edible proportion**	**Kcal**	**Notes**
Alcohol			
Keg Bitter	1.00	31.00	
Lager (1 litre)	1.00	29.00	
Wine (1 litre)	1.00	68.00	
Bread			
Bread, white	1.00	233.00	
Rye Bread	1.00	219.00	
Butter	1.00	740.00	
Cheese	1.00	406.00	
Coffee	1.00	3.00	
Eggs	1.00	147.00	Ed. prop. already included in calc.
Flour & Cornflour			
Cornflour	1.00	354.00	
Flour, white, bread making [non-fortified]	1.00	337.00	
Flour & Cornflour Composite	1.00	345.50	
Fruit			
Apples, eating	0.77	35.00	
Currents, black raw	0.98	28.00	
Peaches, fresh, raw	0.87	32.00	
Peaches canned	1.00	87.00	
Peaches Composite	0.94	59.50	
Pears, eating	0.72	29.00	
Pears, canned	1.00	77.00	
Pears Composite	0.86	53.00	
Prunes raw	0.83	134.00	
Raisins, dried	0.92	246.00	
Fruit Composite	0.88	92.58	
Lard	1.00	891.00	
Meat			
Bacon, rashers, fried, middle, lean and fat	0.51	477.00	
Ham (Canned meats)	1.00	120.00	
Bacon & Ham Composite	0.76	298.50	
Beef (stewed, stewing steak)	0.60	223.00	
Beef (brisket boiled & salted)	0.61	326.00	
Beef forerib (roast, lean and fat)	0.55	349.00	
Beef Composite	0.59	299.33	
Veal, cutlet, fried	0.74	215.00	
Veal, fillet, roast	0.75	230.00	
Veal Composite	0.75	222.50	
Beef & Veal Composite USA	0.59	295.70	Weights: 331.4/36.9, (A)
Beef & Veal Composite Belgium	0.60	291.55	Weights: 40.8/4.6, (B)
Beef & Veal Composite France	0.63	278.05	Weights: 35.5/13.6, (C)
Beef & Veal Composite Germany	0.61	286.64	Weights: 29.8/5.9, (D)
Beef & Veal Composite Great Britain	0.59	296.50	Weights: 10965/420, (E)
Liver (ox, stewed)	0.82	198.00	
Tongue (ox, boiled)	0.38	293.00	
Offal (Beef) composite	0.60	245.50	
Beef & Veal & Offal Composite USA	0.59	289.88	Weights, B&V/Offal: 88.41/11.59 (E)

Beef & Veal & Offal Composite Belgium	0.60	286.21	Weights, B&V/Offal: 88.41/11.59 (E)
Beef & Veal & Offal Composite France	0.63	274.28	Weights, B&V/Offal: 88.41/11.59 (E)
Beef & Veal & Offal Composite Germany	0.61	281.87	Weights, B&V/Offal: 88.41/11.59 (E)
Beef & Veal & Offal Composite Great Britain	0.59	290.59	Weights, B&V/Offal: 88.41/11.59 (E)
Chicken, roast, meat and skin	0.55	216.00	
Liver, chicken, fried	0.84	194.00	
Chicken & Offal Composite	0.56	214.90	Weights: 95/5 (E)
Mutton (scrag and neck, stewed, lean and fat)	0.46	292.00	
Lamb cutlets (grilled, lean and fat)	0.50	370.00	
Mutton & Lamb Composite	0.48	331.00	
Brain, lamb, boiled	0.81	126.00	
Liver, lamb, fried	0.88	232.00	
Offal (Mutton & Lamb) Composite	0.85	179.00	
Mutton & Lamb & Offal Composite	0.52	313.38	Weights, M&L/Offal: 88.41/11.59 (E)
Pork (chops, loin, grilled, lean and fat)	0.49	332.00	
Pork (leg, roast, lean and fat)	0.60	286.00	
Pork Composite	0.55	309.00	
Liver, pig, stewed	0.79	189.00	
Kidney, pig, stewed	0.56	153.00	
Offal (Pork) Composite	0.68	171.00	
Pork & Offal Composite	0.56	293.01	Weights: 88.41/11.59 (E)
Fish			
Dried Fish (kipper)	0.45	205.00	
Fresh fish (cod purchased fried)	1.00	199.00	
Fresh fish (haddock smoked)	0.55	66.00	
Fresh fish (herring grilled)	0.53	135.00	
Salmon, canned	0.94	155.00	
Fish Composite	0.67	118.67	
Milk	1.00	65.00	
Molasses			
Syrup	1.00	298.00	
Treacle	1.00	257.00	
Molasses Composite	1.00	277.50	
Potato	0.86	80.00	
Rice	1.00	361.00	
Sugar	1.00	394.00	
Tea	1.00	4.00	
Vegetables			
Sweetcorn (canned kernels)	1.00	76.00	
Peas (canned, garden)	0.63	47.00	
Tomatoes (canned)	0.60	12.00	
Cabbage (boiled)	0.65	7.00	
Onions (boiled)	0.85	13.00	
Tomatoes (raw)	1.00	14.00	
Turnip (boiled)	0.80	14.00	
Beans, harricot, boiled	2.60	93.00	
Peas (boiled)	0.37	52.00	
Carrots (boiled)	0.87	19.00	
Vegetables Composite	0.94	34.70	
Vinegar	1.00	4.00	

(A) *Cost of Living in American 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 principle Industrial Towns of the United States of America* (London: HMSO, 1911) [CD, 5609.], p. liii-liv ('southern towns' included with four other areas).

(B) *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 principle Industrial Towns of Belgium* (London: HMSO, 1910) [CD, 5065.], p. xv.

(C) *Cost of Living in French 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 principle Industrial Towns of France* (London: HMSO, 1909) [CD, 4512.], p. xix.

(D) *Cost of Living in German Towns: Report of an Enquiry by the Board of Trade into Working Class Rents, Housing and retail Prices in certain occupations in the principle Industrial Towns of the German Empire* (London: HMSO, 1908) [CD, 4032.], p. xxi.

(E) A. R. Prest, *Consumer's Expenditure in the United Kingdom 1900-1919* (Cambridge: C.U.P., 1954), pp. 18-24.