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Nutrition and Growth in Italy, 1861-1911. What Macroeconomic Data Hide.

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Abstract: We investigate how nutritional status responded to economic growth in Italy during 1861-1911. By combining household-level data on food consumption with population censuses, we estimate that the incidence of undernutrition decreased by about 10-15 percent between 1881 and 1901. Consumption of calories responded elastically to income changes, although declining with the level of household income: on average, income elasticity of calories in 1901 was in the range of 0.3-0.6. Malnutrition, defined as the inadequate intake of macro- and micro-nutritients, was reduced. Overall, our findings do not support the pessimists' view, ubiquitous in the Italian literature. On the contrary, the early phase of Italian industrialization was beneficial to the nutritional status of the bulk of the population, and even more so for the poorest among the poor.

Key Words: poverty; undernutrition; malnutrition; nineteenth-century Italy; income elasticity of calories.

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1. INTRODUCTION

Nourishment was likely to be an everyday torment for the major part of the mid-nineteenth century Italian population. Accounts by contemporary observers are surprisingly in agreement when it comes to describing calorie availability and the affordable diet for the bulk of the population: inadequate the former, unbalanced the latter. The following description is worth a hundred such: "Half-baked humid and rancid corn bread, and soup concocted with all manner of poor, at times even noxious, ingredients; rice and pasta of the most inferior quality, stale and rotten pulses, unwashed vegetables, seasoned with a little oil or rancid lard or fat, this the soup prepared for those who labor on the farmer's fields, this the scanty meal of the man who ekes out a living on Lombard soil, the same soil enriched by the sweat from his brow. And this meal is at times so repugnant that the unfortunate peasant is compelled to refuse it." [Cardani and Massara (1868): 28, our translation].

Much on the basis of evidence as gloomy as the above, the pessimists' view – arguing that the nutritional status of the population failed to keep up with per capita income growth rates – has become prevailing within the standard-of-living debate in Italy. Recently, Vera Zamagni has offered an authoritative review of the nutritional regime in Italy between 1861 and 1913. The 'facts' she identified include: *(i)* "low level of calories per head", *(ii)* "monotonous diet", *(iii)* "marginal changes" in the food consumption pattern, and *(iv)* persistence of a "hard-core [of poor individuals], only partially affected by slightly different conditions in the urban proletariat, and even less affected by the much better conditions of a exiguous middle class and of a rich elite." [Zamagni (1998): 175-182]

The pessimists' view does not appear fully consistent with the estimates by the Italian Statistical Office (Istat), according to which, on average, Italians never suffered from a calorie deficit, nor did their diet show major deficiencies with respect to the macronutrients (proteins *in primis*). As early as the year 1861, calorie availability was 2,466 calories per head per day, a value largely exceeding the threshold commonly used by nutritionists to mark the boundary of undernutrition. Recent estimates by Giovanni Federico (2003a) suggest that the Istat's series are likely to underestimate the average calorie availability. Similarly, Stefano Fenoaltea (2002) has argued that "mass well-being rather than mass hardship" was the outcome of Italy's early industrialization process.

The disagreement between contemporary accounts and official estimates is more apparent than substantial, and can be reconciled by noting that most nineteenth-century social inquirers were focused on documenting the standard of living of the working class, and thereby biased towards the have-nots. In contrast, the Istat's estimates originate from the domestic agricultural production and net imports, and the corresponding series do not suffer from a selection bias. Secondly, a high per capita calorie availability is consistent with the presence of a sizable part of the population trying to make ends meet, provided a substantial degree of income inequality can be assumed. This is precisely the finding of Rossi, Toniolo and Vecchi (2001): in 1881 about 7 per cent of total income accrued to the bottom 20 percent of the population, as opposed to 53 per cent accruing to the top 20 percent.

The debate between pessimists and optimists is not settled by the evidence so far available: while 'qualitative' sources drift into pessimism, national account statistics lead to rosier conclusions. Income distribution helps smooth the conflict between the two sources, but it leaves the question at the heart of the living standard debate unanswered, namely who benefited from economic growth, and to what extent.

Irrespective of how refined the new statistical series may become in the future, aggregate time series provide an unsatisfactory basis for assessing the impact of economic growth on population welfare. A first reason is due to the insecure foundations of the system of national accounts.[*] Another reason is that aggregate data do not permit the identification of winners and losers: aggregation negates identification. In order to assess the distributional impact of growth this paper explores the use of household-level data. In practice, the main difficulty in using micro-data is due to its scarcity: household surveys for the nineteenth century are relatively rare for most countries, and even in the fortunate event of having a survey at hand, it is often hard to claim their representativeness of the population under study.

In this paper we follow a simple method which facilitates the use of micro-data in historical analysis. We suggest the use of population censuses (a relatively abundant resource available to economic historians) in order to construct 'raising factors' (weights) with which to post-stratify the micro-dataset. The original collection of micro-data augmented with the weights is then used *as if* it were a 'probabilistic sample' as defined in modern statistical parlance. This method is well established among statisticians, although its relevance to historical analysis seems to have been experimented very little.

The paper enters the "standard of living" debate by using a unique dataset, which contains household-level data on food consumption for the years 1874-1906. The typical record of the dataset includes information on *(i)* the socio-demographic characteristics of household members, *(ii)* consumption (quantities per household) for more than 50 food items, and *(iii)* household yearly after-tax income. On this statistical basis and by applying the method outlined above, the paper provides estimates of *(i)* the incidence of undernutrition in Italy for a number of benchmark years between 1861 and 1911, *(ii)* the elasticities of consumption of calories to per capita income, separately for "the rich" and "the poor", for the year 1901, and *(iii)* the elasticities of consumption of macro- and micro-nutrients to income.

We find that the incidence of undernutrition, defined as the percentage of individuals whose per capita food consumption falls short of 2,000 kilocalories/person/day, fell from 31.9 percent in 1881 to 27.1 percent in 1901. This reduction is largely explained by the growth in average daily per capita calorie supply (80 percent), while the calorie redistribution which occurred between 1881 and 1901 accounted for about 20 percent. By using nonparametric kernel regressions we find that the income elasticity of calorie consumption declined with living standards: households in the poorest quartile of the income distribution have elasticities of about 0.6, which decreases to (at least) 0.3 for households in the richest quartile. A similar pattern holds true for the elasticities of most macro- and micro-nutrients to income.

The relevance of our findings is twofold. As for the longstanding debate between pessimists and optimists, the presumptions of the former are called into question: to the extent to which undernourishment serves as a proxy for poverty, our results imply that the early phase of Italy's industrialization was beneficial to the poor, and even more so to the poorest among the poor. Efficiency went along with equity. Because, as others have noted, Italy's economic record is a success

[*] See Slesnick (1998), and Offer (2003).

story, the results obtained in the paper make Italy a strong candidate for further research on the equity of economic development.

A second implication is methodological. The main lesson to be learned is that the scarcity of historical micro-data (household nutritional budgets in our application) is a limit that can be overcome by integrating the analysis with *(i)* macro-data (here population censuses), and *(ii)* standard analytical tools (post-stratification, as discussed in Holt and Smith (1979)). The gain from combining micro- with macro-data is that the historical analysis can go beyond the paradigm of the representative agent, thus opening the way for a quantitative analysis of the distributive aspects of long-run economic growth. The extension of this approach to other fields of inquiry in economic history is relatively straightforward.

The paper is organized as follows. In section 2 we survey the evidence on nutritional changes for Italy from 1861 to 1911, as depicted by macroeconomic indicators. In section 3 we illustrate a new dataset of food household budgets and the methodology which we adopted to deal with the deficiencies inherent in nineteenth century data in order to make them statistically acceptable to a twenty-first-century palate. We proceed to provide the estimates of undernutrition rates in section 4, and examine nutrient elasticities in section 5. A final section concludes.

2. FOOD CONSUMPTION AND NUTRITION IN ITALY, 1861-1911: WHAT WE KNOW

In the immediate aftermath of Italy's unification, the collection of statistical data on food production and consumption was among the priorities of the statistical office at the Ministry of Agriculture, Industry and Commerce (Maic). Both the Maic and the Parliament promoted inquiries which delivered a relative abundance of statistical material. On this basis, by the year 1957, the Istat completed a comprehensive collection of historical statistics which included the series on food consumption for the period 1861-1955.[†]

Since then, revisions and counter-revisions of national account series have proceeded relentlessly, so that we are now in the position to better appraise the evolution of the nutritional regime during the first half century of the Kingdom of Italy. To this end, Table 1 surveys the evidence for a selection of key nutritional indicators, obtained from Federico's (2003a) new estimates of agricultural output. Starting from per capita calorie (PCC) availabilities and judging from their *levels*, it turns out that Italians have never suffered, on average, from energy deficits: on the contrary, ever since the beginning of the Kingdom, in 1861, the average daily per capita caloric supply was significantly higher than any threshold used by development economists to mark the condition of undernutrition.[‡] As for the *trend* of available calories, it is upward during the entire period.

Two yardsticks are readily available to benchmark the PCC estimates in Table 1. First, nineteenth century Italy can be compared with today's developing countries, at least with those with similar per capita GDP (in 1990 PPP-adjusted dollars). The comparison can be criticized on many grounds, but it can be credited

[†] See Istat (1957), and Cohen and Federico (2001).

[‡] See FAO/WHO/ONU (1985).

with the fact that it aids the understanding of the magnitudes involved in Table 1. According to UNDP estimates, in 1996 about 43 percent of today's less developed countries had a lower supply of calories than Italy in 1861, a percentage which increases to 58 percent in 1911. Considering the advances which took place in food technology during the late nineteenth- and twentieth-centuries, this result is rather revealing. By using the FAO's food balance sheets the evidence is even more clear cut: with rare exceptions, countries with per capita GDP comparable to that of Italy in 1881 fall short of Italy's calorie levels by an amount ranging from 200 to 800 calories.[§]

Table 1 - Nutritional indicators – Italy, 1861-1911.

	1861	*1871*	*1881*	*1891*	*1901*	*1911*
Calories[1]	2,466	2,400	2,508	2,582	2,682	2,752
Macronutrients						
Proteins[2]	88.8	85.2	87.2	89.0	92.2	95.3
- animal origin (%)	17.2	17.1	17.7	18.7	20.6	22.0
Fat[2]	40.3	42.9	50.9	54.3	57.5	55.4
Carbohydrates[2]	404.4	391.6	401.6	409.8	419.5	430.4
Micronutrients						
Iron[3]	84.3	80.4	82.2	83.9	86.8	90.1
Niacin[3]	14.3	13.6	14.1	14.6	15.2	15.9
Vitamin A[3]	534.4	504.9	500.8	521.7	565.4	594.1
For memory						
Heights (cm)	162.8	163.2	163.7	164.2	165.0	166.0
Food share (%)	66.6	67.4	68.1	66.3	64.8	63.8
GDP per head[4]	1,447	1,498	1,543	1,611	1,818	2,453

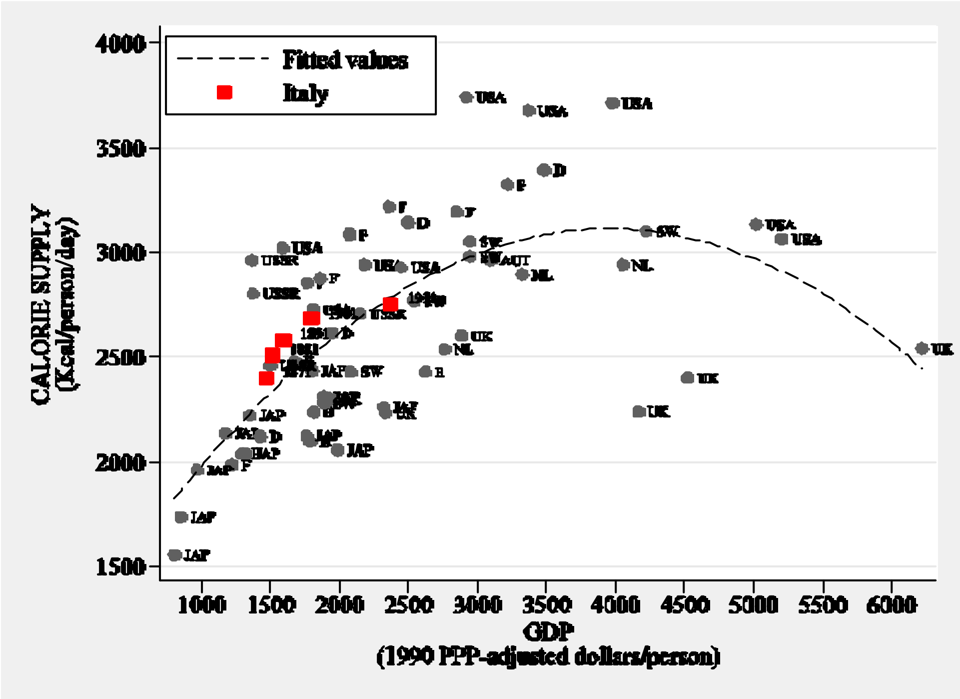
Notes: [1/]kilocalories/person/day; [2/]grams/person/day; [3/]micrograms/person/day; [4/]1990 Geary-Khamis dollars, 5-year moving averages. Theoretical daily requirements (for adult male, 30 or more years old, weight 65 kg) are as follows: protein 62 grams, iron 10 mg, niacin 18 mg, vitamin A 700 mg. See Società Italiana di Nutrizione Umana (1996).

Sources: Calories and nutrients are from Federico (2003a). The quantity-to-calorie coefficients from Carnovale and Miuccio (1989), heights from Istat (1976), food budget shares from Istat (1957), and GDP from Maddison (2001).

A second benchmark is provided by the evidence for countries contemporary with nineteenth-century Italy. Figure 1 shows the scatterplot of calories against GDP (both in per capita terms) for a selection of countries for which data are available. A quadratic model was fitted to the data and the regression line is shown in the graph. The fact that regression residuals for Italy are *positive* during the second half of the century, implies that the model systematically underpredicts calorie supply in Italy. In other words, Italy was systematically better than the average.

[§] Fao estimates 2,300 kcal. for Pakistan in 1987 (1,453 USD), 1,932 kcal. for Indonesia in 1972 (1,363 USD), 2,298 kcal. for China in 1979 (1,420 USD), 1,745 kcal. for Philippines in 1961 (1,488 USD), 2,407 kcal. for Côte d'Ivoire in 1964 (1,422 USD), 2,202 kcal. for Morocco in 1963 (1,455 USD).

Figure 1 – Calories and GDP, selected countries 1780-1940



Sources: ***Belgium (B)****:* Bekaert (1991). ***France (F)****:* Toutain (1971). ***Germany (D)***: Hoffmann (1965), Lemnitzer (1977). ***Japan (JAP)***: Kaneda (1968), Shay (1994). ***The Netherlands (NL)***: Horlings and Smits (1998). ***Spain (E)***: Simpson (1989). ***Sweden (SW)***: Jureen (1956) ***United Kingdom (UK)***: Oddy (1990), Fogel (1994). ***United States of America (USA)***: Bennet and Peirce (1961), Komlos (1987). ***Union of Soviet Socialist Republics*** **(*USSR*)**: Wheatcroft (1999).

Notes: All GDP estimates are in 1990 international Geary-Khamis dollars), as from Maddison (2001).

Calorie intakes may provide a flawed picture of the nutritional regime when the diet is lacking in important nutrients. In order to verify this, the central panels of Table 1 show the composition of the Italian diet in terms of macro- and micro-nutrients. Starting from the former, the main stylized facts can be summarized as follows: *(i)* Consumption of proteins was high, by any standard. Ninety grams/person/day in the year 1861, would rank nineteenth-century Italy in the top quartile of today's' countries (top quintile in 1911); *(ii)* Carbohydrates supplied about 80 percent of the total daily energy, a share in line with other 'traditional economies' of the past, as well as with many of today's LDCs.[**] *(iii)* Consumption of fat was low (consistent with low consumption of meat and dairy products), but followed an upward trend. Because fat represents the form in which people store energy, the pattern in Table 1 describes a steady decrease in the vulnerability of the population to food shortages.

As far as micronutrients (minerals and vitamins) are concerned, Table 1 considers three of these: iron, niacin and vitamin A. Iron deficiency is a cause of anemia, which impairs productivity making people feel weak and listless. Deficiency of niacin (a vitamin of the B group) inhibits the metabolization of

[**] See Baudet and van der Meulen (1982), and Aymard (1975).

proteins, and is responsible for *pellagra*.[††] Vitamin A is a crucial factor in reducing child and maternal mortality, as well as the risk of disease and death from infections. Table 1 points to the existence of deficiencies in the diet of the Italian population (iron being an exception), a result concordant with evidence collected from other sources.[‡‡] Focusing on the period 1881-1911 for which we have safer estimates, Table 1 shows two-digit percentage *increases* for all micronutrients: 10 percent for iron, 13 percent for niacin, and 19 percent for vitamin A.

Among the factors limiting the scope of Table 1, measurement errors deserve special consideration. The process leading from the national account sources to the estimates of nutritional indicators in Table 1 requires a host of assumptions and 'expert opinions' on a long chain of non-testable hypotheses concerning the agricultural production function, and the waste and leakage at various stages of the estimation process.[§§] Measurement errors are likely to increasingly affect the series the more they stretch back in time, thereby biasing trends as well as levels. The major shortcoming of Table 1, however, originates from the very use of national account data, rather than from the accuracy of their measurement. The aggregate level of the data underlying Table 1 does not allow us to address two issues that are crucial to the understanding of the relationship between economic development and nutritional status. First, how widespread was undernutrition as a percentage of the population, and how did the share of the undernourished change over time? Second, who were the undernourished and who benefited (and by how much) from economic growth?

We can try to answer the first question by using 'Fogel's method', as it will be referred to subsequently. In the context of a broader research project on the causes of the decline in mortality and hunger, Robert Fogel (1997) obtained estimates of the incidence of undernutrition by using only macroeconomic data. Fogel's solution hinged on two key assumptions: he hypothesized that the distribution of per capita calories across the population followed a log-normal distribution, and he conjectured that the coefficient of variation of the distribution was between 0.2 and 0.4.[***] Knowledge of the distribution function of per capita calories, allows the straightforward estimation of the incidence of undernutrition as the integral of the density function over the interval delimited by an exogenous calorie cut-off point marking the threshold of undernutrition:

$$\mathrm{IU} = \int_0^{c^*} f(c)dc$$

The above equation obtains the percentage of undernourished (IU) by calculating the area between the distribution function of per capita calories, denoted by *f(c)*, and the calorie cut-off point (c^*).

[††] According to Livi Bacci (1986), pellagra reached a peak in the early 1880s with more than 100,000 pellagrins, and 18,000 deaths in the period 1887-1891, to decline rapidly in the next 20 years.

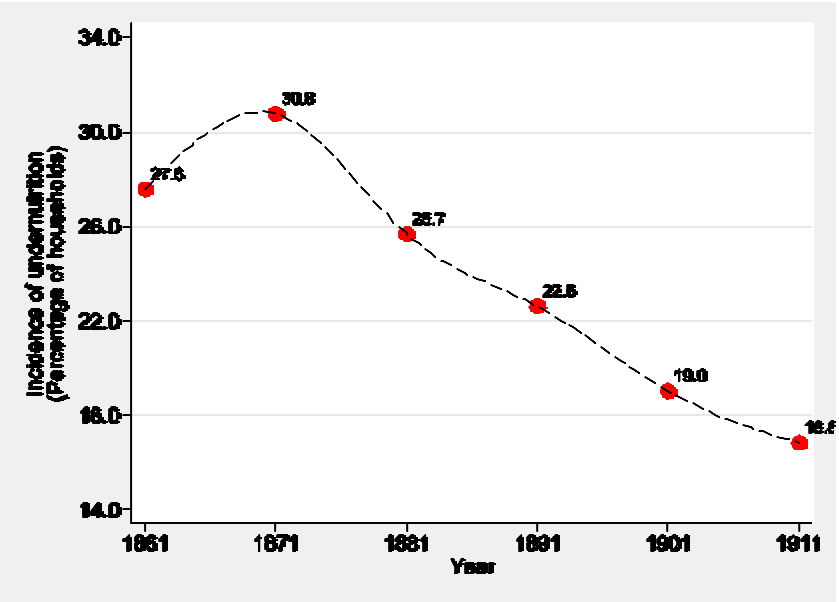
[‡‡] See Sorcinelli (1995).

[§§] See Svedberg (2000) for the general argument. For the case of Italy, see Somogyi (1973), and Federico (2003a).

[***] Following Fogel, Geert Bekaert (1991) estimated undernutrition for Belgium in years 1812 and 1846. James Simpson (1995) obtained the distribution of daily calories for Spain in 1900.

By adapting Fogel's method to the case of Italy, we obtained ten-year interval estimates of undernutrition between 1861 and 1911.[†††] The result is shown in Figure 2, according to which the incidence of undernutrition decreased throughout the whole period 1861-1911.[‡‡‡] Three caveats must be considered in interpreting this result: *(i)* None of the hypotheses upon which the model is based (log-normality and values conjectured for the coefficient of variation) can be tested; *(ii)* No standard errors are attached to the estimates in Figure 2, with the consequence that the trend must be taken at face value; *(iii)* The interpretation of the profile in the figure is conditioned by the tenet that inequality in the distribution of calories remains stable over time.[§§§]

Figure 2 - The incidence of undernutrition in Italy, 1861-1911 ("Fogel's method")



Note: the dashed line interpolates the ten-year intervals point estimates, represented with a small circle. The threshold of undernutrition is 2,000 kcal/person/day.

No medication exist for *(i)* and *(ii)*. As regards *(iii)*, it often represents a counterfactual assumption: in the case of Italy, Rossi *et alia* (2001) showed that inequality in household per capita expenditures decreased between 1881 and 1901, and argued that it decreased even more during the subsequent decade. Nevertheless, in the absence of pathologies in how calorie elasticity varies across the income distribution, Figure 2 may still provide a veracious picture of the *trend* of the incidence of undernutrition. In fact, the simplicity of Fogel's method makes it a convenient tool, able to furnish a quick exploratory look at the trend of the

[†††] Following Fogel, we assumed log-normality for the distribution of per capita calories. The mean of the distribution was estimated on Federico's (2003a) estimates. We modified Fogel's method by using a multiplicity of 'reasonable' values for the coefficient of variation (all in the interval [0.2, 0.4]), and calculated the average of the standard deviations implicitly defined by keeping fixed Federico's mean.

[‡‡‡] The exception represented by the year 1871 not easy to explain, episodic and quickly absorbed, is likely due to major measurement errors. Oral communication of Giovanni Federico to one of the authors.

[§§§] This criticism is not on the Fogel's method, but on its use to make intertemporal comparisons, as implied by Figure 2.

incidence of undernutrition. This is our interpretation of Figure 2 for the case of Italy.

The second question above on *who* the undernourished were and the size of their energy gaps is far more difficult to answer. The analysis carried out in this section, being based on national account data, simply rules out the possibility of identifying undernourished households. Nor does the aggregate nature of macroeconomic data permit the investigation of broad differences in the nutritional regimes of the population, such as regional disparities, rich and poor dietary differences, rural and urban divide, etc.[****] The failure to track changes in the above disparities over time, provides a strong motivation for the use of food household budgets, as we explain in the remaining part of this paper.

3. FOOD HOUSEHOLD BUDGETS

The use of nutritional household budgets to estimate calorie availability at the country level is not new to economists, although attempts to do so for the nineteenth century are rare and limited to a narrow circle of countries.[††††] In this section, we review the sources which include food budgets for Italian households, and describe the dataset which was assembled to investigate the changes in nutrition during the early phase of industrializing Italy.

Data on food consumption at the household level began to be collected in the immediate aftermath of the making of the Kingdom of Italy.[‡‡‡‡] In the wake of the need for appraising the living standards of the population, the Italian parliament and the Ministry of Agriculture, Industry and Commerce (Maic) carried out a number of inquiries in which household data were collected. Nutritional household budgets were also compiled, in a totally uncoordinated manner, by a wide variety of learned men, including physiologists, anthropologists, nutritionists, chemists but also social scientists, politicians, intellectuals, and philanthropists. They all practiced the art of compiling household budgets, even if for different purposes and with different methods. If on the one hand such a smorgasbord of sources adds to the complexity of comparing the data across households, on the other hand it greatly enhances the coverage of the population. While official enquiries were typically concerned with either the working class or the 'average' household, private researchers ranged over a wider field, and their investigations reached out to households located on every step of the social ladder.

Notwithstanding their relative abundance, food household budgets have been exploited only marginally in historical analysis. The literature mostly consists of studies that are rich in descriptive data, but reluctant to venture into making inference about the whole population.[§§§§] A possible explanation can be the fact that the data available are too fragmented to permit any inference at all. In many authors this argument is implicit, while others spelled it out clearly. Luigi Einaudi had few doubts on the fact that household budgets represented "historical

[****] See Albertoni and Novi (1894), Raseri (1879), and the bibliography in Sorcinelli (1995).

[††††] See Oddy (1990), Shammas (1984), and Logan (2003).

[‡‡‡‡] See Bottazzi, Niceforo and Quagliarello (1933), Niceforo (1933), Somogyi (1959) and Vecchi (1999).

[§§§§] See however Horrel and Humphries (1992), and Federico (1991).

documents, not statistical ones" [Einaudi (1936): 88]. Similarly, Stefano Somogyi, compared household data to a 'kaleidoscopic mosaic' [Somogyi (1973)], which only permits a glimpse at a richer, though irremediably veiled, texture.

To overcome the above difficulties, in this paper we adopted the approach introduced by Rossi *et alia* (2001), based on post-stratification, a statistical technique aimed at 'offering protection against unfavourable sample configurations' [Holt and Smith (1979): 33]. In a nutshell, consider a population of N units (households in our application), and partition it into H strata of sizes N_1, N_2, …, N_H, such that $\sum_h N_h = N$, summing h from 1 to H. Strata might correspond to geographical regions, for example. Suppose that in order to make inference on a certain characteristic of the population (PCC in our application) we have a sample of size n, which can be similarly partitioned into H strata of sizes n_1, n_2, …, n_H, such that $\sum_h n_h = n$. In the absence of a sampling design, there is no reason to expect n_h/n to be equal to N_h/N, *i.e.* there is no reason to expect the sample to mimic the proportions of the population. In fact, it is likely that the discrepancies between sample and population proportions will be large, reflecting the degree to which selection bias affects the data. For this reason, it is necessary to correct the sample, and post-stratification provides an easy way of doing so: it requires the calculation of N_h/n_h, which will subsequently be referred to as 'raising factors' or 'weights', and the weighting of each observation with them. An account of the whole procedure as applied to the present context is best illustrated by breaking it down into two steps.

Step 1 consists in assembling the data on food household budgets. For the years 1878 – 1906 we were able to find 374 food household budgets. In order to cope with the heterogeneity of the surveying methods, we organized every budget within a common structure: a typical record of the dataset is shown in the annex. Observations were allocated to one of two samples according to their vintage: budgets referring to years 1871 to 1891 were brought together to form the '1881 sample', while those for the years 1892 to 1911 formed the '1901 sample'.[*****] On the account of the paucity of observations we were unable to form a sample for the year 1911.

Step 2 deals with the representativeness of the samples obtained *sub* step 1. We cross-classified sample observations according to *(i)* the geographical area of residence (Center-North *versus* South-Islands) and *(ii)* the economic sector of activity of the head of the household (Agriculture *versus* Other sectors). Table 2 shows that the resulting partition produces four *strata* for each sample. The number of observations in each stratum (n_h in the notation above) is shown in bold type. In order to post-stratify the samples we used population censuses to calculate the raising factors which were assigned to each observation in the datasets: equal weights were assigned to observations within the same stratum, and different weights to observations in different strata. In Table 2 weights (N_h/n_h) are in italics: they show the number of population households represented by each sample household. For instance, 18,817 in the first stratum of the 1881 sample implies that each of the 90 center-north agricultural households in the sample is taken to represent 18,817 households in the population. The lower the stratum size, the heavier the burden of representativeness on each sample observation.

[*****] We allowed the two samples to share 30 observations in order to cope with non-coverage issues.

Table 2 – Post-stratification of food household budgets

	Center-North	*South-Islands*	*Italy*
		1881	
Agriculture	**90** *18,817*	**37** *36,750*	**127**
Other	**46** *40,546*	**15** *86,506*	**61**
Total	**136**	**52**	**188**
		1901	
Agriculture	**15** *126,787*	**131** *11,705*	**146**
Other	**31** *67,568*	**9** *162,592*	**40**
Total	**46**	**140**	**186**

Note: bold-type denotes the number of sample observations. Italics are used for raising factors, which give the number of population households represented by each of the sample households in each stratum.

In order to figure out the extent to which post-stratification was effective in delivering 'protection against unfavourable sample configurations', we compared sample estimates of the mean PCC with the estimates obtained from Federico's (2003a) food production series. For the year 1881 the discrepancy between the two estimates is negligible (Federico obtained 2,508 calorie/person/day, our sample gives 2,513 calorie/person/day). For the year 1901 the discrepancy is about 4 percent, (2,682 calories in Federico's, 2,571 in our estimates). A more pronounced divergence emerges when we compare trends: according to Federico's estimates, between 1881 and 1901 calorie availability increased by 6.9 percent (0.33 percent per year), which compares to 2.3 percent (0.12 per year) in our samples. Discrepancies of this order of magnitude, however, are low, especially if one considers the sizes of our samples: for instance, in comparing PCC consumption as estimated from food consumption surveys and food production data for a number of less developed countries, Svedberg (2000) has shown that the average discrepancy is around 10 percent.

4. UNDERNUTRITION AND MALNUTRITION: THE ESTIMATES

The terms 'undernutrition' and 'malnutrition' are used here to designate different facets of a nutritional regime: by undernutrition we mean a situation of calorie deficiency, as defined by most international agencies: "an household is undernourished if the daily per capita caloric availability falls below the level required to sustain the physical activity socially advisable and necessary to the economic maintenance".[†††††] In contrast, we use the term malnutrition to denote an unbalanced dietary regime, characterized by inadequate intakes of macronutrients (proteins, glucocides, fats) and/or micronutrients (minerals, vitamins). [‡‡‡‡‡] Although malnutrition is often a consequence of undernutrition, the link is not automatic and we will distinguish between the two concepts.

[†††††] See FAO/WHO/ONU (1985), p. 12. See also FAO (2001).

[‡‡‡‡‡] Intakes are inadequate if they falls below the recommended daily requirements defined by the Italian Society of Human Nutrition (*Società Italiana di Nutrizione Umana*) (1996).

Table 3 – Undernutrition in Italy, 1881 and 1901

Households	***1881***	***1901***	***Change (%)***
Incidence (%)	28.6	25.5	- 10.8
Depth (%)	5.8	5.1	- 12.1
Severity (%)	2.1	1.4	- 33.3
Mean Calorie Gap	404.5	404.1	- 0.1
Individuals			
Incidence (%)	31.9	27.1	-15.0
Depth (%)	7.6	5.4	-28.9
Severity (%)	3.2	1.4	-56.0
Mean Calorie Gap	477.5	397.0	- 16.9
For memory			
Total Population (thousand)	28,460	32,616	+ 14.6
Number of households (thousand)	6,216	6,999	+ 12.6
GDP per capita (1990 international $)	1,543	1,818	+ 17.8
Gini index on PCE	0.448	0.397	- 11.4
Share bottom 20% on PCE	6.7	7.2	+ 7.5

Note: The threshold of undernutrition is 2,000 kilocalories/head/day.

An array of undernutrition estimates is shown in Table 3, which establishes a number of facts.[§§§§§] First, households cohabiting with undernutrition represent a substantial proportion of the population over the whole period 1881-1901. By setting the threshold for undernutrition (henceforth, undernutrition line) to 2,000 kilocalories/person/day, we estimated that in 1881 28.6 percent of households (corresponding to about 9.1 million individuals) were undernourished.[******] By 1901 the incidence of undernutrition decreased to 25.5 percent, although demographic growth implied an extra burden of 4 million individuals to feed, with the consequence that the count of undernourished individuals was 8.8 million.[††††††]

Second, during 1881-1901 the incidence of undernutrition *decreased* by at least 15 percent, and possibly more if a lower undernutrition line is used and/or other measures of undernutrition are adopted.[‡‡‡‡‡‡] If an allowance is made for differences in the demographic composition of households, the incidence of undernutrition decreases even more markedly: the distribution of calories per adult

[§§§§§] See also Vecchi (2003).

[******] Gopalan (1983) noted that thresholds that may be adequate for evaluation of the nutritional status of a given individual may not be suitable for the assessment of the nutritional status of a whole population. Livi Bacci (1991) accounting for the difference in (average) stature and weight between the populations of the past and today's populations, concluded that: "Leaving aside inequality issues, a population which could count on a normal consumption of 2,000 calories per person would have been, in the past centuries, a sufficiently well-fed population, at least from the point of view of energy availability." [55-56]. The discrepancy between the estimates in Table 3 and those in Vecchi (2003) are due to the increased sample size underlying the former.

[††††††] Whether to interpret the evidence in Table 3 in support of the argument 'poverty has decreased dramatically' (minus 25 percent) or 'poverty has hardly changed' (minus 300 thousand undernourished individuals in twenty yeas) is not trivial. See Kanbur (2003).

[‡‡‡‡‡‡] The result is consistent with Figure 2, where Fogel's method delivered a more generous reduction (minus 26 percent), and is robust to the choice of the cut-off point.

equivalent shows that undernutrition decreased by the 20 percent, the depth index by the 24 percent, and the severity index by the 49 percent.

The incidence of undernutrition fails to account for the extent to which households fall short of a minimum calorie requirement: it is possible for undernourished families to experience important increases in daily calorie availability without any variation being registered by the undernutrition measure.[§§§§§§] A measure for the depth of undernutrition can easily be obtained by calculating the mean energy deficit of undernourished families, and expressing it as a share of the undernutrition line: this measure is often called the poverty gap index, and henceforth we will adopt this terminology. According to the estimates in Table 3, between 1881 and 1901 the poverty gap index decreased by roughly 29 percent, indicating a dramatic reduction in the degree of nutritional deprivation within the set of undernourished families.

Table 3 shows the estimates for a third measure of undernutrition ('Severity'), whose defining characteristic is to weight households according to their energy gap: the higher the household energy deficit the higher the weight attached to the household in measuring undernutrition. The main advantage of the 'severity index' lies in its sensitivity to changes in the distribution of calories among the undernourished: a decrease in the severity index implies that the poorest among the poor have increased their calorie consumption more than proportionally.[*******] This is what happened between 1881 and 1901 when the severity index decreased by 56 percent, implying that the most undernourished families benefited in a consistent way from the increase in the mean availability of calories.

Table 4 – Who was undernourished?

	1881		1901		Change (%)	
	North Center	South Islands	North Center	South Islands	North Center	South Islands
Incidence (%)	31.6	24.5	24.9	26.2	- 21.2	6.9
Depth (%)	7.2	3.9	4.8	5.6	- 33.3	43.6
Severity (%)	2.7	1.3	1.3	1.5	- 51.9	15.4
Mean Calorie Gap	455.0	318.0	386.0	426.0	- 15.2	34.0
Gini index	21.3	15.4	19.4	14.9	- 8.9	- 3.2
	Agric.	**Other**	**Agric.**	**Other**	**Agric.**	**Other**
Incidence (%)	28.6	28.6	30.2	20.9	5.6	-26.9
Depth (%)	5.8	5.8	5.7	4.6	-1.7	-20.7
Severity (%)	2.3	1.9	1.4	1.4	-39.1	-26.3
Mean Calorie Gap	404	405	377	441	-6.7	8.9
Gini index	18.8	19.3	18.8	19.0	0.0	-1.6

Note: percentages refer to households, not to individuals.

Table 4 shows who the undernourished were and how their identity changed in the last twenty years of the century. Sample sizes did not permit any finer breakdown of the data, but even so the story told by Table 4 is fresh and worth telling. The main results can be summarized as follows:

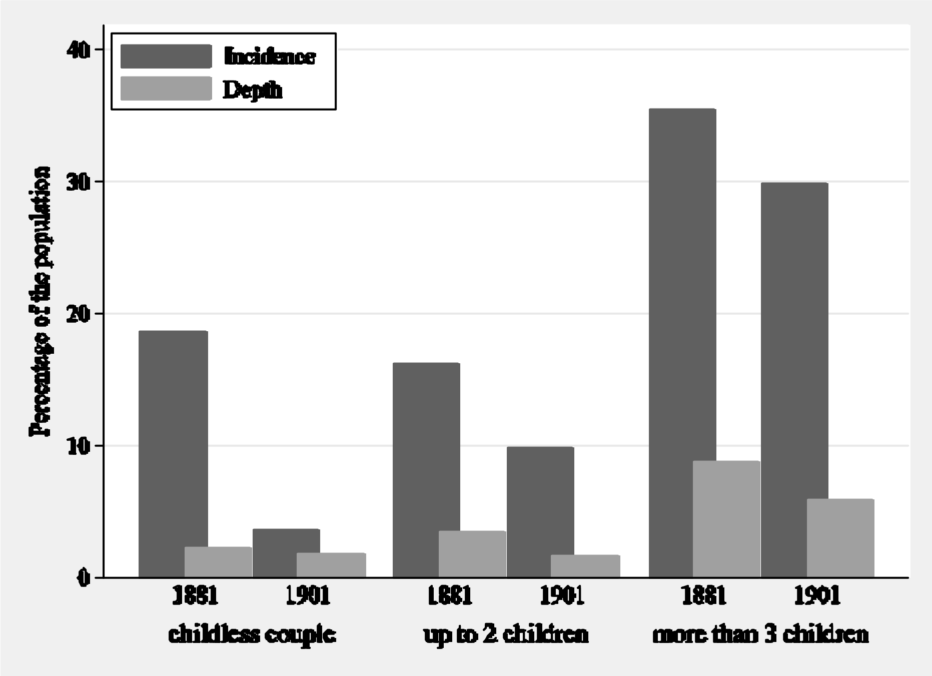
[§§§§§§] See Sen (1976).

[*******] See Foster, Greer and Thorbecke (1984), and Ravallion (1994).

- In 1881 the center-north of Italy showed undernutrition rates higher than in the south-islands: living in the southern regions lowered the probability of being poor by 15%, and gave a calorie premium of 130-140 calories per day. By taking into account population shares, about 63 percent of undernourished households were located in the North-Center of the country.
- By 1901 the geography of undernutrition had undergone a reversal: during the twenty years preceding the turn of the century undernutrition headed south. While in the center-north regions undernutrition decreased dramatically (between minus 21 and minus 52 percent, depending on the measure adopted), southern regions saw an increase in undernutrition.
- The improvements in calorie availability in the center-north probably originated from the growth in average PCC rather than from the redistribution of calories within the region (the Gini index shows a mild decline). The higher levels in PCC benefited the poorest among the poor more than proportionally: this is the main implication from observing the changes in undernutrition rates which are higher in depth than in incidence and even higher for the severity index.
- Insights on the poor performance of the south-islands are derived from observing that the distribution of PCCs barely changed (minus 3.2 percent in twenty years), while the depth index showed a terrific increase (plus 44 percent). These two facts together suggest that behind the result shown for the south is the lack of growth in PCC. More precisely, the magnitudes of the changes in Table 4 indicate negative growth rates for PCC among the undernourished.
- In 1881 the sector of activity of the head of the household did not appear to have any impact on the distribution of undernutrition. It is difficult to rule out the possibility that this result is blurred by the fact that the non-agricultural sector includes a heterogeneous set of households. The problem is probably mitigated if data are differenced, thereby considering the trend between 1881 and 1901. By doing so, and by the extent to which the agriculture-other divide provides a proxy for the urban-rural divide, the estimates in Table 4 show an unambiguous pro-urban bias in the process of reduction of undernutrition.

The relationship between undernutrition and demographic structure of the household is illustrated in Figure 3, which shows the estimates for the incidence of undernutrition and the poverty gap index (depth of undernutrition) broken down by household size. Three findings are worth emphasizing. First, during the whole period 1881-1901 the fact of living in a larger-than-average family (5 or more components), increased the risk of being undernourished by 10 percent, while living in a small household decreased the risk of undernutrition by at least 40 percent, which further decreased to 50 percent for childless couples. Second, although both the incidence and the depth of undernourishment decreased between 1881 and 1901, the reduction pattern is not uniform. Undernutrition rates fell dramatically for both households with no children (incidence decreased by 80 percent for households with one or two components) and for households with up to two children (minus 40 percent), while in large households undernutrition decreased by 16 percent. Third, the widening gap in the undernutrition risk between small and large household suggests that economic development caused high-fertility households to lag behind in the escape from undernutrition.

Figure 3 - Undernutrition and household size



To conclude this section, we must still to consider the evidence on malnutrition. The main results are shown in Table 5. Notwithstanding the fact that the diet remains traditional in type (carbohydrates and vegetables remain the main daily energy givers), the variations registered in the consumption of macronutrients point to an overall improvement in the diet of the Italian population. The consumption of carbohydrates decreased, as did that of vegetable proteins, in favor of consumption of higher quality nutrients such as fats and animal proteins. Given the difference in the cost per gram of the above mentioned nutrients, it is improbable that the variations shown in the table can be explained only through a substitution effect (a change in relative prices): the degree to which the consumption of animal proteins increased, for example, suggests that such a change was made possible by an increase in available income.

Table 5 – Macro- and micro-nutrients: Italy, 1881-1901

Macronutrient (grams/person/day)	*1881*	*1901*	*Change (%)*
Protein	84.7	85.2	+ 0.6
- animal origin	10.3	12.1	+ 17.5
Carbohydrates	495.4	486.2	- 1.9
Fats	25.8	29.2	+ 13.2
Micronutrient			
Iron	22.9	19.9	- 13.1
Vitamin A	349.9	485.9	+ 38.9
Niacin	19.8	15.2	- 23.3
Calcium	321.9	325.5	+1.1

The analysis carried out in this section shows that undernutrition *decreased* between 1881 and 1901, both in spread and in depth. The growth in average PCC reached the bulk of the population, although the process was not distributional-neutral. Nutritional gains accrued more than proportionally to households in the north-center regions of the country, with the breadwinner employed in non-agricultural activities. The pro-urban character of the undernutrition reduction process is, at present, an informed conjecture: it, however, fits the pattern found in the correlation between household size and undernutrition rates, as well as the changes in society which are usually associated with urbanization. As far as the qualitative aspects of the diet are concerned, estimates show a general improvement: there is a significant increase in the consumption of animal proteins, as well as in the consumption of fats. All in all, the results indicate that the transition towards a modern type of nutritional structure has its roots in the last decades of the 19th century.

5. NUTRITION AND GROWTH

The responsiveness of household nutrient intake to income is a key element in designing effective policy reforms in less developed countries. As Subramanian and Deaton (1996) have put it, "trade policy, pricing and tax policy, and project evaluation would all be done differently in a world in which the promotion of real incomes did not meet the objectives of development", Because hunger eradication certainly ranks high among the latter, it is not surprising that the debate on the size of nutrient elasticity to income holds center stage. The conventional wisdom which has come out of surveys until the late 1970s maintains that economic growth is successful in defeating hunger. Behrman and Deolalikar (1987) questioned this view, by arguing that the "true nutrient elasticities with respect to income may be close to zero" [492]. Underlying the idea of a flat calorie Engel curve is the hypothesis that the poor spend their marginal income to substitute quantity of calories with quality, variety and taste.

In the context of this paper, the zero-calorie-elasticity hypothesis would be at odds with the fact that during a period of relatively low GDP growth (plus 0.82 percent per year in real per capita terms between 1881 and 1901) undernutrition decreased by between 15 and 56 percent. In this section we provide estimates for a number of nutrient elasticities to income and expenditure. Our findings show that calorie elasticity is *at least* 0.6 for the poorest households, and presumably not higher than 0.3 for the rich. This explains why economic growth was effective in fighting undernutrition in late nineteenth- century Italy, and represents a finding worth delivering to development economists.

In order to carry out the investigation, only a subset of the sources illustrated in section 3 could be used, viz. those containing information on *both* food consumption *and* household income or expenditure. This implied a dramatic reduction in sample sizes, which made the analysis safe only for the 1901 sample.

Table 6 shows the results of parametric estimates for variations of the following constant elasticity model for per capita calorie consumption (PCC, dependent variable):

$$(1) \qquad PCC = \alpha_0 + \alpha_1 PCI + \alpha_2 HSIZE + \alpha_3 SOUTH + \alpha_4 OTHER + \varepsilon$$

where PCI is household per capita income after tax (in log), HSIZE is household size (in log), SOUTH is a dummy variable taking on 1 if the household lives in south-islands and 0 otherwise, OTHER is a dummy equal to 1 if the head of the household is employed in the non-agricultural sector.

Table 6 – Calorie elasticities to expenditure: parametric estimates. Italy 1901

Dependent variable: log of per capita calorie consumption				
	(1)	(2)	(3)	(4)
LOG PCE		0.397 (6.62)**		0.384 (6.62)**
LOG PCI	0.361 (6.87)**		0.331 (6.70)**	
SOUTH			-0.466 (4.45)**	-0.279 (2.32)*
OTHER SECTOR			-0.488 (5.60)**	-0.262 (2.18)*
HSIZE			-0.215 (2.86)**	-0.150 (1.69)
Constant	5.825 (22.26)**	5.615 (18.98)**	6.803 (18.18)**	6.198 (14.43)**
Observations	155	129	155	129
R-squared	0.14	0.30	0.43	0.35

Notes: Robust t statistics in parentheses, * significant at 5%; ** significant at 1%. The annex provides further evidence on the robustness of the specification.

Results in Table 6 tell a plausible story. First note that the point estimates in the table range between 0.331 to 0.397, which matches the elasticity implicit in the macroeconomic record in Table 1 (0.389) very well. Second, the elasticity of per capita calories is quite responsive to both income and expenditure: it tends to be higher in the former than in the latter, although the difference is not statistically significant. Living in the south decreases the level of PCC, which is consistent with southerners' higher risk of being undernourished as found in section 4. Household size reduces PCC, which is what we expect given the correlation existing between household size and per capita household expenditure or income. The negative sign associated with OTHER is consistent with the findings in Table 4, in which it was shown that the incidence of undernutrition in the non-agricultural sector decreased, while the depth of undernutrition increased (9 percent in the poverty gap ratio).

The main problem with model (1) is its linearity, which forces the calorie elasticity within a clearly unrealistic straitjacket: calorie and nutrient elasticity are commonly found to vary with the standard-of-living, as a consequence of the fact that the least well-nourished persons tend to make the largest nutritional changes as their budget shifts.[†††††††] As far as the incidence of undernutrition is concerned, the relevance of the argument is assessed in Figure 4, which shows the non-parametric kernel regression functions for *(i)* the demand function of per capita calories (left panel), and *(ii)* the elasticity of PCC as a function of PCI (right panel). The model estimated is the following:

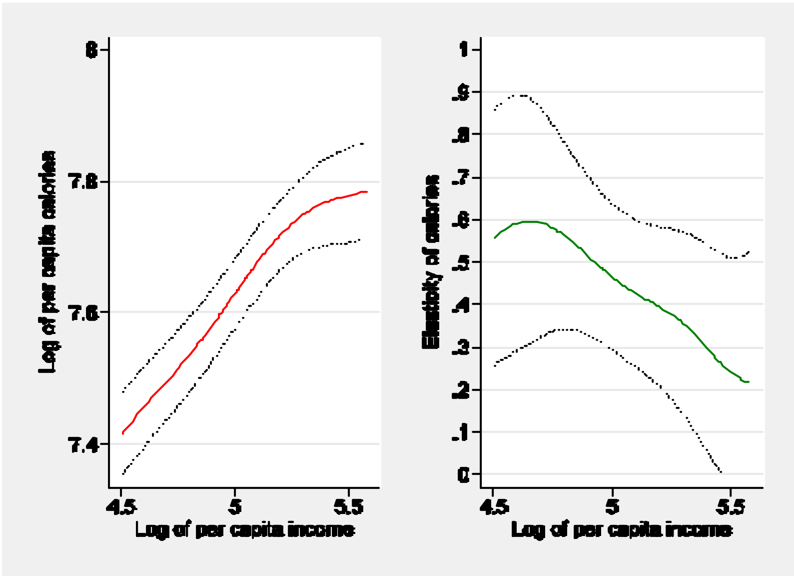
(2) $$PCC = m(PCI) + u$$

where u is the disturbance and *m(PCI)* is the conditional mean of per capita calories (PCC) given per capita income (PCI). The estimated version of equation (2) is shown in the left panel of Figure 4. Of greater interest, to our purposes, is the calculation of the derivative of *m(PCI)* with respect to PCI (the calorie elasticity), without imposing constraints on its shape. The estimates of such derivative are

[†††††††] See Ravallion (1990).

found in the right panel of Figure 4, and show that calorie elasticity declines with per capita income, from about 6 percent for the poorest households (lowest quartile) to 3 percent for rich households (top quartile). In fact, Figure 4 is likely to provide a conservative estimates of the steepness of the elasticity decline, in that both curves in the figure were obtained after a trimming of both the extremes of the PCI scale: for reasons dictated by the kernel regression method a small, though not negligible fraction of the very poor and the very rich were excluded from the sample, a fact which tended to flattening out the curve.[‡‡‡‡‡‡‡]

Figure 4 – Calories and income: Nonparametric estimates, Italy 1901



Note: Left panel shows the nonparametric regression function for log of calories and log of income. Bootstrapped standard errors were used to estimate the 90% confidence interval (dot lines are upper and lower bounds). Right panel: Elasticity of calories (person/day) to PCI.

A potential problem with Figure 4 is that it provides estimates which take no account of household size or other household characteristics whose omission could be the source of bias in the estimates. In particular, one might expect that the pattern of marginal effects shown within the parametric estimation framework might hold, at least to a certain extent, also for the non-parametric estimates. This bias could therefore shift the elasticity curve downward, and possibly tilt it towards the prediction of the constant elasticity model in equation (1). In order to rule out this possibility one should increase the number of covariates in equation (2), by including other variables in the *m()* function. Although viable in theory, very little can be done in practice because of 'the curse of dimensionality'. Econometricians use this expression to refer to the problem arising from the relationship which links *(i)* the number of covariates in equation (2), *(ii)* the sample size, and *(iii)* to the convergence rate with which nonparametric estimates (elasticities in our application) converge to their 'true' values. The 'curse' consists in the fact that in order to increase the number of covariates in the regression one must accept an enormous slowdown in the convergence rate (*i.e.* a high risk of biased results). Our

[‡‡‡‡‡‡‡] When data are too sparse, as it happens in the tails of the PCI distribution, the the kernel regression performs poorly and the overall effect is to blur the graph. See Silverman (1986).

own attempt to challenge the curse of dimensionality is reported in the annex and shows that the elasticity curve in Figure 4 is remarkably stable even when household size is accounted for.

Table 7 – Elasticities of Nutrients to Income by PCI quartiles

		Mean elasticities within the PCI quartiles			
	Elasticity at the mean	**1 (poorest)**	**2**	**3**	**4 (richest)**
Calorie	0.438	0.573	0.475	0.409	0.296
Macro-nutrients					
Protein	0.461	0.597	0.510	0.360	0.245
- Animal	1.169	2.230	1.380	1.067	0.814
- Vegetable	0.353	0.591	0.395	0.293	0.190
Carbohydrates	0.315	0.457	0.348	0.286	0.233
Fats	0.444	0.475	0.449	0.451	0.473
Micro-nutrients					
Vitamin A	0.842	1.025	0.918	0.777	0.634
Calcium	0.328	0.375	0.347	0.309	0.262
Iron	0.477	0.643	0.537	0.397	0.279
Niacin	0.213	0.554	0.268	0.169	0.062
For memory					
PCI[1/]	—	97	158	207	373
Calorie[2/]	—	2,201	2,514	2,686	2,962
Income/calorie	—	44	63	77	126

Note: 1/ Per capita income (1901 Lire/per year).

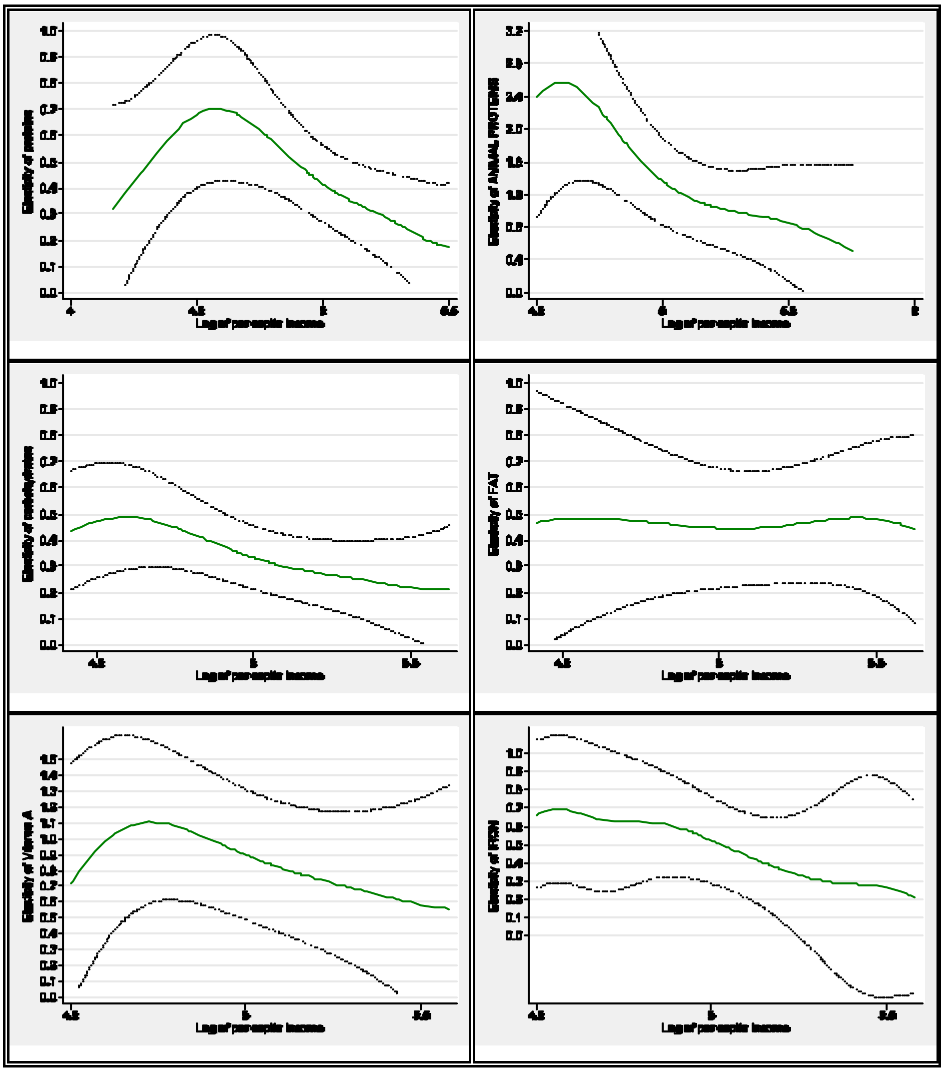
In addition to the elasticity of calories to income, we estimated the elasticity for a number of macro- and micro-nutrients. shows the pattern, while in Table 7 we report the point estimates of the elasticities computed at different points along the income distribution. These results contain a number of points of interests:

1. *All elasticities have positive sign.* The overall implication is that the increases in income did result in improvements in nutrient intakes. The general pattern of elasticities which decline with PCI but remain positive even for the richest households suggests that improvements in nutrient intakes must be substantial.
2. *Calorie elasticity*. In line with the 'narrow capacity of the human stomach' argument, calorie elasticity halves when passing from the bottom extreme of the income distribution to the top one. In between, near the mean income, calorie elasticity is 0.438, which is in line with the estimate in Table 6, obtained parametrically.[§§§§§§§]
3. *Protein elasticity*. The pattern of the estimates in Table 7 leads to the conclusion that in the process of getting richer households replaced vegetable with animal proteins, i.e. they substituted quantity for quality, a common finding in historical accounts of dietary changes. Animal proteins remained a luxury good throughout the period considered and, even if elasticities were declining with PCI, they maintained this characteristic across most of the income distribution. The elasticity for the poor (0.597 for the lowest quartile) tallies with Clark's 0.612 for the UK at the end of the 1830s.

[§§§§§§§] On comparing the results for Italy in 1901 (GDP per capita circa 1,800 in 1990 international dollars) with those obtained by Clark et al. (1995) for poor workers in the UK 1837-41 (GDP per capita circa 2,000 international dollars) we also find concordance among the estimates: Clark's elasticity of 0.434 is close to ours.

4. *Carbohydrate elasticity.* The relative low level of the elasticity of carbohydrates is consistent with the fact that the largest share of household energy comes from carbohydrates (mainly cereals), a fact which suggests, at least to some extent, satiation with respect to carbohydrates and the desire to widen the variety and/or increase the quality of the food bundle.
5. *Fat elasticity.* Further research is needed to explain the flat profile observed for fat. Arguably, when income increases much substitution takes place within the broad category 'fat': cheap oily substances are increasingly replaced with expensive and better tasting fats.
6. *Micronutrient elasticities.* The pattern of vitamin A closely tracks that of animal proteins, partly because they are likely to be correlated (vitamin A derives from the consumption of food of animal origin such as eggs, meat, and milk. To a large extent the pattern of other micro-nutrients is also correlated with the trend observed in macro-nutrients, so that they do not add any particular insight to the picture. Moreover, the divergence which often arises between availability and assimilability may be particularly broad for micro-nutrients, a fact which adds to the difficulty of interpreting this evidence.

Figure 5 – Nutrient Elasticities to Income: Nonparametric Estimates



Overall, the estimates in Table 7 depicts Italy at the eve of twentieth century as a country having a number of features typical of developing countries, most notably the fact that nutrients of animal origin are luxury goods. Nevertheless, the low elasticity of carbohydrates suggests that in 1901 Italian households escaped, by and large, the regime of severe energy deprivation. Even households in the bottom 25 percent of the income distribution could afford to add 'variety' to their diet: they traded energy against quality, cheap calories contained in carbohydrate-rich food items against more expensive (and better tasting) calories contained in animal food.

6. CONCLUSIONS

Despite the enormous literature triggered by the seminal works of Simon Kuznets (1955;1966), the results obtained in the historical reconstruction of the impact of "modern economic growth" on the distribution of income are not entirely satisfactory. For most countries we only have conjectures, more often guesses, on how long-run economic growth affected inequality in the distribution of income, and the spread and depth of poverty.

Lack of suitable statistical data is frequently described as the impediment to the identification of the beneficiaries of economic development. In this paper we explore the use of micro-economic data (food household budgets) to estimate an array of undernutrition measures and track their evolution during the early phases of Italy's industrialization. Our findings question the traditional view, according to which the nutritional regime between 1881 and 1901 was characterized by "low mean calorie intakes", by "marginal changes" in diet and by a "hardcore" of undernourished sectors of the population. In contrast, our estimates show that the average Italian was sufficiently nourished as from the beginning of the Kingdom of Italy, as much in terms of calorie availability, as in terms of nutrients. The improvements registered in dietary composition were large, as was the reduction in the percentage of undernourished individuals. The geography of undernutrition underwent a clear-cut change during the last twenty years of the century: poverty, initially more concentrated in the centre-north regions, "headed south" and abandoned families employed in non-agricultural activities. The emphasis placed so far on the hardcore, on the chronicity of poverty and on the excessive immobility of the social structure is therefore called into question.

The results presented in this article fit neatly into the macroeconomic picture newly outlined by the on-going revisions of the production series (industrial as well as agricultural).[********] Between 1881 and 1901 the real GDP per head increased by 18 percent; during the same period, the inequality in the distribution of total family expenses diminished (Rossi et al. (2001)). A process of growth not sterilized by increases in inequality *must* imply a reduction in absolute poverty; this is algebraically certain. To the extent to which poverty, expressed in monetary terms, is positively correlated to undernutrition, the substantial decrease registered in the measures of undernutrition that emerges in this paper, is in line with the expectations of economists in the context of liberal Italy. The pro-urban and pro-north bias in the undernutrition reduction process is also consistent with Fenoaltea's (2003) recent study on the regional pattern of industrial growth, according to which starting from 1881 "in most of the southern regions (…)

[********] See Federico (2003a) (2003b), and Fenoaltea (2002).

lagging industrial development seems to have dragged down the entire economy" [1082]. Our findings also agree with Federico's (2003a) improved estimates of agricultural output.

As to the debate between pessimists and optimists, the reduction of the phenomenon of undernutrition in the period from 1881-1901 supports the conclusions reached by Fenoaltea (2002): "(…) the 1880s were a period of mass well-being rather than of mass hardship (…) and only the "optimist" view of the 1880s is consistent with a unified interpretation of Italy's economy over the half-century to the World War." [280] Our estimates adds a further element of optimism by noting that the most undernourished in the population reaped the greatest benefits.

In order to give a comprehensive account of the pattern of undernutrition, a number of important dimensions which were not covered in this paper should be addressed. Nutrition in late nineteenth-century Italy was significantly affected by the seasonal character of food production, and households were often unable to smooth their food consumption across seasons. Moreover, both energy supply and dietary composition were vulnerable to idiosyncratic negative shocks hitting harvests. Presumably, rural households were more vulnerable than urban ones; a fact which would foster the pro-urban bias that emerged in our findings. Third, piecemeal evidence suggests the existence of important disparities in intra-household allocation of food consumption, children and women being subject to lower dietary regimes. To tackle the above issues could imply retouching the portrait depicted in this paper, and this provides directions for future research.

One concluding remark is on the implications of this paper regarding the research *method*. The analysis carried out shows that the scarcity of micro-economic data (*i.e.*, nutritional budgets) is a limit that can be overcome when the latter data is used in combination with other sources of statistical information (*i.e.*, population censuses), by using of standard analytical tools (*i.e.*, post stratification). The gain here is that the analysis can go beyond the paradigm of the representative agent and therefore open the way for a quantitative analysis of the distributive aspects of long-run economic growth.

7. ANNEXES

Table 8 The food household budget of a Florentin sharecropper (1878)

Description	Example
Socio-demographic variables	
Year	1878
Household size	6
Gender (for each member of the household)	M/F/M/F/F/M
Age (for each member of the household)	32/28/5/3/27/3
Municipality	Roccasancasciano
Branch of activity of the head of the household	agriculture
Job of the head of the household	sharecropper
Food consumption (kg.)	
Cereals (total)	1740
Bread	0
Cakes	0
Flours (total)	980
Wheat flour	0
Maize flour	980
Flour, others	0
Rice	0
Pasta	0
Meat (fresh and salty)	24.25
Veal	0
Beef including veal	0
Beef	10
Pig	0
Mutton and goat	0
Horse	0
Poultry	14.25
Offals and others (rabbit, frog, snails…)	0
Tinned meat	0
Fresh meats (total)	24.25
Salted and preserved meats	0
Fresh and preserved fish	10
Fresh and frozen fish	0
Dry and preservedfish (dry, smoked, preserved in oil…)	10
Eggs and milk products (excl. butter)	84.6
Milk	0
Cheeses (fresh and matured)	15
Eggs	69.6
Oils and fats	38
Oils (total)	8
Olive oil	8
Vegetable oils (excl. olive oil)	0
Butter	0
Lard	30
Vegetable margerine	0
Others fats (bacon, bacon fat…)	0
Pulses (fresh and dry), vegetables and fruit	496
Pulses (fresh and dry), vegetables	461
Pulses (fresh and dry)	61
Fresh pulses (total)	0
Beans	0
Fresh broad beans	0
Fresh pulses, other	0
Dry pulses	61
Vegetables and fruit (total)	435
Potatoes	300

Fresh tomatoes	0
Canned tomatoes (tomato purée)	0
Vegetables, others	100
Fruit (total)	35
Fresh fruit (excl. citrus)	…
Citrus	…
Dry fruit	0
Preserved fruit	0
Sweeteners, hot beverages and miscellaneous	0
Sugar	0
Jams and sweets	0
Hot beverages (coffee, tea…)	0
Miscellaneous	0
Beverages	736
Mineral waters	0
Fruit juices	0
Wine and light wines	736
Beer	0
Other alcoholic beverages	0

Note: "…" denotes a missing value.
Source: J.P. Assirelli (1896), *Paysan métayer de la Commune de Roccasancasciano (Romagne-Toscane-Italie)*, "Les Ouvriers del Deux Mondes", serie 12, issue 23, Librairie De Firmin-Didot, Paris.

Table 9 – Elasticities of Nutrients to Income by PCE quartiles

		Mean elasticities within the PCE quartiles			
	Elasticity at the mean	**1 (poorest)**	**2**	**3**	**4 (richest)**
Calorie					
Macro-nutrients					
Protein					
- Animal					
- Vegetable					
Carbohydrates					
Fats					
Micro-nutrients					
Vitamin A					
Calcium					
Iron					
Niacin					
For memory					
PCI 1/	—	97	158	207	373
Calorie 2/	—	2,201	2,514	2,686	2,962
Income/calorie	—	44	63	77	126

Note: 1/ Per capita income (1901 Lire/per year).

Figure 6 – Kernel Regression of PCC on PCI and household size

(coming soon)

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