**Online Appendix**

**Summary Statistics**



**Correlation Matrix**



**Vital statistics seasonality comparison Bilbao - Burgos**



**Statistical pre- and post-examination**

All variables in logs have been previously tested for stationarity, both in levels and in first difference.[[1]](#footnote-1) We have performed two tests to contrast the null hypothesis of a unit root (Augmented-Dickey-Fuller [ADF] and Phillips-Perron [PP] tests) and one test to contrast the null hypothesis of stationarity (Kwiatkowski, Phillips, Schmidt, and Shin [KPSS] Test). We find that all the log variables are trend stationary[[2]](#footnote-2) or their first differences are I[0] integrated respectively. This is a pre-condition for constructing the models shown both in the article and below, and will be helpful, as the coefficients in the distributed lag fits may be interpreted as close proxies to elasticities.

TABLE A

Stationarity tests for detrended birth rates, detrended death rates and detrended real wages. All tests in levels and with intercept

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Augm. Dickey-Fuller**  **(ADF) H0: unit root** | **Phillips-Perron**  **(PP) H0: unit root** | **Kwiatkowski-Phillips-Schmidt-Shin**  **(KPSS) H0: stationarity** |
|  |  |  |  |
| Birth Rate detrended | -7.032\*  [1] | -11.575\*  [5] | 0.1019\*\*  [9] |
| Death Rate detrended | -7.242\*  [0] | -7.289\*  [5] | 0.1684\*\*  [8] |
| Real Wage detrended | -3.873\*  [0] | -3.572\*  [5] | 0.2218\*\*  [11] |
|  |  |  |  |

Note: [] indicate lag length or Newey-West bandwidth in Bartlett kernel estimation. Augmented Dickey Fuller and Phillips-Perron test for unit root. \*rejects null hypothesis of unit root at 5 % level. Kwiatkowski-Phillips-Schmidt-Shin tests for stationarity. \*\* cannot reject the null of stationarity at a 5 % level. Critical values for ADF and PP are 1% — 3.455; 5% — 2.872; 10% — 2.573. Asymptotic critical values for KPSS are 1% — 0.739; 5% — 0.463; 10% — 0.347.

Our first approach to relating the economic stress with vital statistics will be a multivariate (linear) time series model because it allows us to approximate the tie between the variables we are relating without imposing an explicit theoretical idea of the dynamic relations between them. VAR analysis can also be indicative of possible weak causality (Granger causality). This seems most appropriate as a first approximation. From there we will go on to formulating different cointegration models, whose best fit lead us back to a distributed lag model similar to those promoted by Lee (1981) that better reflect the functional relations that we may assume between variables and will allow us to get a better intuition of the magnitudes and timing involved (Richards, 1983; Hammel, 1985; and Weir, 1984). The autoregressive distributed lag models are included in the article.

An easy way to start is to replicate the fits in the VAR models proposed by Nicolini (2007), Fernihough (2010) or more recently by Pfister and Fertig (2017). According to the stationarity test the vector of detrended birth rates, death rates and wages [CBR, DR, W] in natural logarithms can be assumed covariance stationary.[[3]](#footnote-3) As one should expect the results shown below do not reflect a Malthusian scenario as those found for preindustrial societies. But the exercise shows what we have been postulating throughout our paper: **a strong and significant negative short-term influence of real wages on mortality**. But what is important to see here, is that there are no significant influences between vital rates and real wages with the exception, of course, of death rates. We can also see that the effect is not immediate; it has a lag of 2 months. The magnitudes of the variations implied are hard to interpret due to the data transformations and the fact that the results may be biased because of simultaneity. But imposing the standard established ordering of the variables, we can give an idea of the response of death rates to an unexpected increase in the current value of real wages with a VAR impulse response analysis.

TABLE B

VAR Model Coefficients. (Standard error in parenthesis)

|  |  |  |  |
| --- | --- | --- | --- |
| VAR model  coefficients | Birth rates  detrended | Death rates detrended | Real Wages detrended |
|  |  |  |  |
| BRD(-1) | 0.269\*\*\* | 0.021 | 0.012 |
|  | (0.067) | (0.098) | (0.031) |
|  |  |  |  |
| BRD(-2) | 0.230\*\*\* | 0.367\*\*\* | 0.047\* |
|  | (0.06855) | (0.09996) | (0.03185) |
|  |  |  |  |
| DRD(-1) | 0.057 | 0.596\*\*\* | -0.005 |
|  | (0.044) | (0.065) | (0.021) |
|  |  |  |  |
| DRD(-2) | -0.061\* | -0.169\*\*\* | 0.002 |
|  | (0.043) | (0.063) | (0.020) |
|  |  |  |  |
| WD(-1) | 0.074 | -0.010 | 0.732 |
|  | (0.138) | (0.201) | (0.064) |
|  |  |  |  |
| WD(-2) | -0.164 | -0.448\*\*\* | 0.192\*\*\* |
|  | (0.138) | (0.202) | (0.064) |
|  |  |  |  |
| C | 1.866\*\*\* | 1.220\*\*\* | -0.070 |
|  | (0.277) | (0.404) | (0.129) |
|  |  |  |  |

Note: \* denotes significance at 10%, \*\* at 5% and \*\*\* at 1%

The response is shown with one-standard-error bands that yield confidence intervals of approximately 66%. We can see that the unexpected increase in real wages causes a persistent decrease in mortality that reaches its trough after 5 months and fades away slowly over the next five years. According to the VAR model we have specified, the contribution of the variability in real wages on the variability of death rates over six years is 21 %, i.e. over one fifth of the fluctuations in mortality can be explained by the rise and fall of real wages.

FIGURE A

Response of death rate detrended to a one standard deviation real wage detrended innovation



**Additional statistical post-examination for robustness of results**

1. Data preparation. We have created three data sets: crude data, data with missing observations interpolated with moving averages (only for temperatures and pawns), and de-seasonalized data
2. We include two exogenous data series which will also be considered as a robustness check for weather: Temperatures and rainfall
3. We also include seasonal dummies for data analysis with crude data and interpolated data.
4. Significance levels to consider: standard practice 1%, 5% and 10%
5. Selection criteria: AIC and BIC.
6. Unit root tests: ADF and KPSS
7. Calibrating optimal number of lags using selection criteria
8. Checking on Granger causality. See validity of a VAR model
9. We run co-integration tests conditioned on unit root tests, lags, seasonality, and exogenous variables included.
10. We estimate the following models: VAR (1), co-integrated VAR, seasonal VAR (conditioned on the co-integration test); VECM; ADL regressions

Results:

1. Data: best results are obtained with crude data and seasonal dummies
2. Including the two exogenous variables for weather adds nothing, their effect is in the seasonal dummies
3. Optimal lag length is 4 for death rates, 3 for other socio-economic and vital statistics
4. Selection criteria – tried both mode of BIC and AIC and finally decided to use AIC which is most appropriate for monthly data.
5. Unit root tests for all variables I (1). Additional unit root test with structural change: Busetti- Harvey also show all series I (1)
6. We perform Johansen co-integration tests and generate impulse-response functions for the different models we obtain.
7. Impulse-response functions show how transitory disequilibria are corrected and stabilized positively with COLI indexes and negatively with nominal wages.
8. Evidence of co-integration with all variables with the exception of child abandonment (Fixed-basket COLI does show evidence of cointegration with child abandonment). Otherwise results with changing weights COLI and fixed weight basket COLI are very similar.
9. Models: preferable model is VAR (1) which is similar to ADL and VECM with no long-run relations.
10. Models free of self-correlation (tests prior to first difference regressions)

**Data description and sources**

The nominal wage series were reconstructed from surviving company records and secondary sources which have used the same company’s records. Two of the biggest Spanish iron and steel firms merged with a tinplate mill in 1901 and their archives were deposited in the new firm: Altos Hornos de Vizcaya. The records were originally consulted at the firm archive in Baracaldo. Since then this archive has been donated to the Archivo Foral de Bizkaia [AFB/BFA]. The monthly wages for blast furnace workers at the Baracaldo factory of Altos Hornos de Vizcaya from January 1914 to December 1921 are taken from the cost accounting books (Libro balance del ejercicio de [year] de la Sociedad Altos Hornos de Vizcaya.). Their signatures are: AHV 0295 [1914], AHV 0297 [1915], AHV 0298 [1916], AHV 0299 [1917], AHV 0300 [1918], AHV 0302 [1919], AHV 0303 [1920], AHV 0304 [1921]. Average Baracaldo factory wages from January 1922 to December 1927 were taken from AHV 0305 [1922], AHV 0306 [1923], AHV 0307 [1924], AHV 0308 [1925], AHV 0309 [1926], and AHV 0310 [1927]. Catálogo del Archivo Histórico de la Diputación Foral de Bizkaia, Consulted on January 18th, 2022. URL: <http://apps.bizkaia.net/ARIT/servlet/webAgentARIT>. Annual averages for 1928 to 1936 have been taken from González Portilla (1984: 74 and 85) (quoted as taken from the ‘libros de cuentas de AHV’ Ejercicios 1902-1936, Consejo de Administración y Carpeta Financiera).

All other series have been taken from *Boletín Mensual Estadístico Sanitario de Bilbao* [Jan 1897 to Sep 1921] and *Boletín de la Estadística Municipal de Bilbao* (December 1913 to October 1921 and February 1923 to December 1936]. Consulted on January 18th, 2022 as available online. URL: <https://www.bilbao.eus/cs/Satellite/archivosMunicipales/Consulta-de-Boletines-Estadisticos/es/1272990914934/Contenido>.

The price data from October 1921 to May 1922 was supplemented with data from the *Boletín del Instituto de Reformas Sociales* and data from October 1919 to July 1921 was supplemented by product price data which had been collected from municipal records at the Archivo Municipal de Baracaldo by José Manuel González Vesga.

The series extracted from the *Boletín Mensual Estadístico Sanitario de Bilbao* and *Boletín de la Estadística Municipal de Bilbao* are marked with an asterisk [\*] in the descriptions below.

Burials expressed the number of persons buried in the extramuro Derio cemetery. Monthly data collected by Juan Gondra Rezola.

Death rate calculated by dividing monthly burials by population (multiplied by 12 to annualize and divided by 1,000 to express as ‰). Monthly population interpolated with the annual population\* data

Infant mortality was calculated using the annualized number of children less than one year of age who died\* in the corresponding month (multiplying the number by 12) and dividing this number by the number of children born during the twelve preceding months\*. For 1914, we have no data on the preceding months, and we have used 2,600 births, which is the annual average for 1914-1916 during these years; the number of births remained fairly stable.

Child mortality expressed as per thousand births. (number of children who died between the age of 1 and five\* divided by the number of children born\* and multiplied by a thousand.

The birth rate was calculated by multiplying the number of monthly births\* by 12, divided by population\* and multiplied by 1000 to obtain ‰.

Stillbirths expressed as the number of monthly stillborn babies\* divided by the sum of births\* and stillbirths\* and multiplied by 1,000 to obtain ‰,

Nuptiality in our case is a crude marriage rate. It is the number of marriages\* times 12, divided by population\* and multiplied by 1,000 to obtain ‰.

Pawns is the total number of pieces of clothing pawned in the corresponding month\*

Meals served in soupkitchen is the number of total meals served by the private and public soup kitchens\*

Rainfall mm of rain registered in Punto Gallarta\* complemented (especially for 1916 and 1917) and controlled for with data from C. **Almarza Mata, J. A. López Díaz y C. Flores Herráez (1996): *Homogeneidad y variabilidad de los registros históricos de precipitación de España*.** Madrid: Ministerio de Medio Ambiente, Dirección General del Instituto Nacional de Meteorología. The series we use are very similar to Almarza et al. (1996) for 1914-1920. For 1920 to 1930, they did not report data for Bilbao, and we interpolated missing data with their series for San Sebastian.

Temperatures registered for Punta Gallarta\*.

Children left in child homes\* number of boys and girls entering theCasa Provincial de Expósitos, an institution created in 1880 to take care of orphans and abandoned children. Many of these children come from the Casa de Maternidad (maternity home), situated in the next building. Mothers had the option to remain with their children during lactation and were paid to feed their children and others. The institution was financed by the regional government. This series has two spikes, one in 1916-1918 and the other in 1930-1931. These coincide with major drops in real incomes. The data can discriminate boys and girls, but we found there to be no gender bias.

Children and elderly left in homes\*

3,000 calorie meals served in Soup Kitchens\*

So with these records and bulletins we have been able to put together a very homogeneously sourced data base for the purpose of our analysis. The monthly frequency of all our series allows us to better gauge the temporal impact of economic stress on families. Family expenditures have been assembled from a single source: basic food prices, housing and heating costs —all published by the Bilbao municipal statistics office. These are used to calculate a family cost-of-living index rather than a single worker’s cost-of-living index. We have collected detailed male worker’s incomes for the major employer in the Bilbao estuary. These nominal male wages include both day-labour remuneration and all extra pay (piece rate premiums and overtime pay). Combining male wage incomes and family expenditure we have a partial picture of how real average family incomes balanced over the period, both for skilled and unskilled workers. Our main contribution is calibrating family expenditure in terms of energy requirements. We use the carefully devised energy balance comparing benchmark working-family’s energy requirements and the energy their nominal male-wage income can command.

**Discussion of data: Nominal incomes and cost-of-living**

**Nominal incomes**

Fortune has conserved the exceptionally detailed nominal income series for the largest iron and steel concern in Bilbao and Spain for this period. Altos Hornos de Vizcaya [AHV] was created by merger of two of the leading iron and steel companies with a smaller tinplate factory in 1901. They employed 5,905 workers in 1916 and 8,300 in 1930, approximately one third of the workers employed in the Spanish iron and steel industry.

In figure B we compare the annualized average monthly wages with other nominal wage series. Both the average wage and the unskilled wage (packers, loaders and mill-shop helpers) move close to the bands of the skilled and unskilled nominal wages calculated by Vilar Rodríguez (2004) for all of Spain up to World War I [WWI]. The post-war years bring about an abrupt upward change of level, situating both wages 25-30% above Vilar’s levels. They do remain nevertheless within the bands of maximum and minimum wages registered by the Bilbao Trade Board Bulletins until the late twenties. For the 1930s Altos Hornos de Vizcaya’s average wages remained an average 9 % higher than the Trade Boards reported maximum. If the higher nominal wages introduce a bias in the analysis, it will be a bias against our hypothesis of family vulnerability.

FIGURE B

Nominal wages Altos Hornos de Vizcaya compared



Figure C below shows the evolution of index number nominal wages available for Biscay iron and steel workers (skilled, unskilled and miners) and rural workers in Navarre compared to the annualized monthly nominal wages we have for Altos Hornos de Vizcaya, both for unskilled workers (*peones de movimiento*) and the average factory wage.[[4]](#footnote-4) Unskilled labour wages adjusted faster and more to the price increases in the 1920s. We see this as indicative of unskilled workers living closer to sustenance, which made them more belligerent in collective action and employers more responsive to their demands for nominal wage adjustments.

Pedro María Pérez Castroviejo (1992) has carried out a very detailed study of the workforce pertaining to the Altos Hornos de Vizcaya factories for the period 1900 to 1915 using the company’s worker books (Libros de Matrícula), and management records. Based on his findings we know that, in those 15 years, 64 % of the newly hired workers came from other provinces (out of a total of 23,847). Nevertheless, the main source of population growth in industrial Bilbao over the first third of the twentieth century was not immigration, but the natural population growth based on high birth rates and descending death rates (González Portilla, 2001 [V1]: 141). This pattern was only briefly altered during the WWI upswing, when immigration regained prominence for a brief period.[[5]](#footnote-5) In 1914, 94.71 % of the AHV labour force were men, 74.1 % younger than thirty-nine years of age. Over 50 % of them had been hired between the ages of 20 and 29 years. Over two thirds spent less than 6 years at Altos Hornos de Vizcaya. Around 74 % of the workers that left their jobs, did so voluntarily, mainly to work in other jobs or for family reasons. High wage opportunities also seemed prevalent elsewhere. Hiring and average wages show no seasonality. Between 1910 and 1915 28.24 % of the workers were married (Perez Castroviejo, 1992: 41-219). In 1930 the payroll of Altos Hornos de Vizcaya represented approximately 40 % of the workforce living on the west side of the Nervión sea-river —the main industrial area of Bilbao (González Portilla, 2001: 139 & 1995: 171).

Not only are we looking at the highest paid workers in the iron and steel industry, but possibly at one of the highest paid work-force in Spain (Pérez Castroviejo, 1992: 115 & 122). The subtlety in these series is that their source are the company payrolls: they reproduce the gross income of workers. The predominant work system in the AHV factories were piecework contracts by which a base task wage was set and all additional work effort was paid as premiums or overtime. The series include both the wage and all other pay received (seniority, productivity and overtime). This is quite a unique source and should increase the precision of our measurement of family incomes considerably.

The nominal earnings for workers presented here splice three series. All three series are taken from the same source and for the same factory. The first series is an average monthly income which includes day wage, other premiums and overtime payment for a blast furnace worker at Altos Hornos de Vizcaya.[[6]](#footnote-6) It runs from January 1914 to December 1921. We have chosen blast furnace workers, because their income is close to the overall average AHV workers’ income, and because they were subjected to high temperatures and very strenuous workloads.[[7]](#footnote-7) This allows us to define a high-energy food basket. We will come back to these points further ahead. From January 1922 to December 1927, we no longer have detailed data on a shop-floor level and only have the average monthly income of all workers at the factory including bonuses and extra hours. And finally, from January 1928 to July 1936, we have interpolated monthly averages from annual averages because we have no monthly observations.[[8]](#footnote-8) The nominal wages are thereby representative in two ways. They represent the average income for the factories —between five to eight thousand workers— and they represent the average income of a blast furnace worker —a high-wage high-energy worker.

FIGURE C

Indexed nominal wages Biscay, Navarre and Altos Hornos de Vizcaya. (1913=100)



The incomes shown in Figure 1 of the article are gross nominal incomes for a high-energy worker. The dotted red line running through the graph depicts what nominal wages would have been if they had evolved at the annual rates proposed by Vilar Rodríguez for average industrial nominal wages in Spain.[[9]](#footnote-9) But economic strife was sure to hit more unskilled workers first. Figure 2 compares the income of skilled and unskilled workers in the same factory. Unskilled labourers are packers, loaders and mill-shop helpers employed in moving raw materials, intermediate products and final products within the factory. Their income remained below the minimum cost of the consumption bundle up to 1920. Their gap to the higher incomes closed during the war and the first two post-war years, as we commented in Figure C.[[10]](#footnote-10)

**Calculation and discussion of cost-of-living**

The conventional approach taken by standard of living analysts —especially those examining the pre-industrial and the industrializing context— is to measure a level of material well-being and seeing how much material well-being nominal wages command over time. For populations emerged in the early phases of modern development (industrialization) this can be approximated using series of nominal wages and the cost of clothing, housing, and nutrition. The classical method has been to transform nominal wages to real wages with a cost-of-living index [COLI]. The evolution of real wages over time then reflects whether material well-being for wage earners has improved or not.

FIGURE D

Comparing Cost-of-living Indexes for Spain, Biscay and Bilbao. (1913 = 100)



Figure D gives a first picture of the cost-of-living index we have calculated for Bilbao from 1914 to 1936 —the thick line in the graph. The cost-of-living index for Bilbao is an annualized arithmetic mean of the upper and lower bound calculations we have performed. When compared to the annual indexes calculated by Ballesteros (1997) for Spain and Biscay and that calculated by Pérez Castroviejo (2006) for Biscay, we find a high degree of co-movement over the WWI and post-war decade. For the second half of the 1920s our index shows closer ties to the Spanish index evolution, and it situates above both after 1929. During the period we examine, it replicates the same movements and trend as the Spanish COLI. This may have its origins in the fact that for much of our approach, we have followed the work method of Ballesteros (1997). Both indexes also follow the money in circulation very nicely. The big difference to both Ballesteros (1997) and Perez Castroviejo (2006) has been calibrating of a constant energy consumption bundle for a working-class family. Real income —wages plus extra pay for overtime or piecework— and the real cost of a fixed energy consumption bundle, representative for a working-class family, will enable us to construct energy welfare ratios, similar to those proposed by Allen (2001).[[11]](#footnote-11)

For most of the steps taken to calculate the cost-of-living, we follow previous work by Ballesteros and Feinstein. Both suggest using consumer retail prices registered in markets and taken from a single source rather than wholesale prices or prices taken from institutions’ accounting books.[[12]](#footnote-12) We have been fortunate to find monthly retail price data registered by the Bilbao municipality and published in their monthly bulletin.[[13]](#footnote-13) Ballesteros’ second principle for her calculations of the Spanish CPI was to choose products which remain homogeneous over time, this is to avoid concerns about quality and composition changes in the consumer goods. Most of the goods we have included have little margin for quality change over time or contain a seal of precedence (such as stockfish from Iceland, chickpeas from Castile, etc.).

A major concern has always been the choice of goods to include in the consumer bundle in order to reflect consumer preferences and habits adjusted to family budgets. We know from Ballesteros for nineteenth century Spain, that there was a limited list of commodities consumed by the average Spaniard: bread, potatoes, legumes, lard, oil and very little meat. Wine and brandy were the main energy complements. Most authors coincide that about 70 % of worker family budgets was spent on nutrition (Reher and Ballesteros, 1993; Fusi, 1975: 37; Pérez Castroviejo, 2006). The remaining 30 % of the budget has been allocated to housing, clothing and other expenses. We also know that during the first third of the century Spaniards added new products such as milk, beans, stockfish, eggs, sugar and coffee to their diets (Simpson, 1989; Cussó, 2010; and González de Molina et al., 2014). We have made an effort at including these changes in the composition of the bundle over time. Compared to previous studies, our bundle also includes a higher than average consumption of legumes and a lower than average consumption of potatoes. The amounts we have chosen of both commodities better reflect their real weight in Biscayan diets, and in terms of calories these differences compensate each other out.[[14]](#footnote-14)

Given that we are examining a limited geographical space which witnessed very rapid change in economic and social structure over a period of sixty years (1876-1936), we have addressed the new goods bias directly by introducing these products as they appear in average family consumption. Substitution bias has been contrasted with a sensitivity test which compares our cost of the bundle to a charity organization’s cost. We assume charities have privileged access to any possible cheap substitution and their long-term contracts and storage capacity smooth out price shocks. They definitely help us mark a lower bound. These adjustments make no difference in the significance of our vulnerability contrasts. This comes to say that the results we obtain are driven by the overall interaction of prices and nominal wages and not by possible price bias in the composition of the family food basket.

In the period we examine, we have assumed the average work effort in terms of calorie requirements to remain constant.[[15]](#footnote-15) Therefore, when altering the weights of different products in the bundle, we have kept energy content in nutrition stable. Our point of departure has been to calibrate three food bundle benchmarks which provide the same amount of calories required by an average family over the time period, but at the same time the difference in their composition reflect changes in diet and preferences.[[16]](#footnote-16) The first bundle for 1894 reflects a diet based on menus taken from Pérez Castroviejo *et al*. (1996) for a Bilbao poorhouse and family consumption patterns observed by working-class newspapers and labour inspectors.[[17]](#footnote-17) It has a high-carbohydrate content, proteins are provided mainly by stockfish and lard, and the food diet is complemented by abundant wine consumption.

The bundle for 1914 reflects important changes in the preferences and products available to average consumers: carbohydrates, lard, stockfish and wine (which we may consider inferior products) are replaced with higher quantities of meat, fresh fish, eggs, milk, oil and sugar. Weights are based on school budgets, school menus, family diets and have been contrasted with hospital food accounting.[[18]](#footnote-18) Six detailed school menus from 1914/15 taken from Bilbao school canteens have been contrasted with spending records in the Bilbao Basurto hospital for 1915, 1916 and 1924 to calibrate the food basket. Following Medina-Abaladejo and Calatayud (2020) in that patients during that time period are prone to be from the more disadvantaged classes of society, we assume that hospital spending on food can be regarded as similar to that normally taken by workers. Over half the workers living in the Bilbao municipality were unskilled labourers and they and their families were the greater part of the patients at the Basurto hospital around 1914 (González Portilla 1995: 297).

For the 1934 bundle we have maintained these substitution trends in the changing consumer preferences but at decelerating rates. In a second step we have interpolated the weights linearly month-by-month between the three benchmark bundles. This gradual shift in the composition of the food basket maintaining calorie content at the same level corrects for some of the bias introduced by substitution and changes in preferences over time. As a reminder, we assume that quality of products remains constant over the period. We add house rent for a working-class family accommodation and the cost of heating and cooking coal. An exception to the assumption of constant quality may be housing, which improved throughout the period examined.[[19]](#footnote-19) But excess demand maintained housing prices high and the changes in rents registered by the Bilbao municipality show a similar trend as food prices. Table C below shows the benchmark food bundles for 1894, 1914 and 1934.

TABLE C

Food commodity bundles for a 5-member nuclear blast-furnace worker family

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Kcalories  per Kg/l | 1894  Kg/l | 1914  Kg/l | 1934  Kg/l | Above  Below | | Average 1930  consumption Spain |
| **Bread** | 2,660 | 2.00 | 1.75 | 1.50 | **👎** | 1.72 | |
| **Rice** | 3,600 | 0.13 | 0.11 | 0.09 | **👎** | 0.12 | |
| **Beans and Chickpeas** | 3,330 | 0.70 | 0.50 | 0.45 | fn. 11 | 0.14 | |
| **Potatoes** | 690 | 1.15 | 0.90 | 0.75 | fn. 11 | 2.29 | |
| **Lard** | 9,020 | 0.21 | 0.13 | 0.09 | **=** | 0.09 | |
| **Meat** | 2,780 | 0.01 | 0.33 | 0.50 | **👍** | 0.18 | |
| **Stockfish** | 2,900 | 0.30 | 0.20 | 0.15 | **👎** | 0.18 | |
| **Oil** | 8,840 | 0.02 | 0.15 | 0.20 | **👍** | 0.16 | |
| **Sugar** | 3,870 | 0.03 | 0.10 | 0.15 | **~** | 0.16 | |
| **Eggs** | 756 | 0.03 | 0.10 | 0.20 | **👍** | 0.06 | |
| **Sardines** | 888 | 0.10 | 0.30 | 0.45 | **👍** | 0.00 | |
| **Wine** | 830 | 1.40 | 1.00 | 0.80 | **👎** | 1.09 | |
| **Milk** | 610 | 0.46 | 1.00 | 1.50 | **👍** | 0.74 | |
| **Family Kcalories** |  | 13,460 | 13,460 | 13,460 |  |  | |
| **Man Kcalories** |  | 4,000 | 4,000 | 4,000 |  |  | |
| **Average Kcalories** |  | 2,690 | 2,690 | 2,690 |  | 2,426 - 2,854 | |

Sources: Calories - USDA National Nutrient Database and Simpson (1989). Average consumption Spain 1930 is calculated using average harvests 1929-1932 in Simpson (1989).

Note: last column, last row: 2,426-2,854 kcal average cal per person per day in Spain using Simpson’s estimations of average consumption clearly point at high seasonality of heavy workloads and unaccounted for food complements in family diets in most of rural Spain. Both sources of underestimating family energy balances are less relevant in an industrial urban context where workload is regular and complementing diets more difficult to come by.

The central 1914 basket is key to the exercises we are to perform. It compares well to the average consumption of food items in northern Spain reported for 1885/1913 by Pujol-Andreu and Cussó (2014: table 7). Higher consumption of fish, wine and fats, slightly reducing the consumption of bread, potatoes and legumes is justified, as Bilbao will be further advanced in its nutritional transition, as is including milk at 104 litres per person per year (see Hernández Adell, 2012: table 4.8). Market availability is coherent with Gallego Martínez (2016). Other adjustments, such as considering nutrients (proteins, calcium, iron and vitamins) or a linear programming adjustment to price changes, is beyond the present scope of our analysis (see Cussó Segura, 2005; Cussó Segura et al., 2018; and Zegarra, 2021).

A few words need to be said to explain why we choose families as consumption and production units in our comparisons. Our work-horse for the analysis is a nuclear family whose male parent works for the wages collected from Altos Hornos de Vizcaya. Very consciously we have chosen a wage earner working at the blast furnace. We calibrate the family basket to this high energy worker. The energy in the basket compared to the energy the high-effort nominal wages can buy, will tell us when the family is over or under its energy level. Our assumption of course is that other worker’s family baskets and wages moved proportionally —nominal wages reflect energy effort in a high-energy setting (loading and unloading at docks, open-cast mining, transport, iron and steel mills, ship-building, metallurgic trade). Thereby when our work-horse nominal wage moves below the nominal price of the family energy basket, we presume all families to move closer to energy sustenance levels. We are interested in seeing this energy balance as a thermometer of family wellbeing or family stress.

The vast majority of families over this time are registered a male-wage family system. According to municipal registries only 9.41 % of married women in Bilbao worked contractually in 1900 and by 1935 this had decreased to 3.71 %.[[20]](#footnote-20) Traditionally Bilbao had developed a low-pressure nuclear-family system before industrialization, similar to that of north-western Europe. In Bilbao the majority of non-inheriting rural migrants and urban population, both men and women, engaged as apprentices and life cycle servants between the ages of 10 and 25 in guilds, commerce and households. Thereby they accumulated expertise, skills and, most important, dowries and assets for founding family units. The mining boom, iron and steel and metallurgic trade altered this demographic model only slightly. Immigrants were pushed into patterns of late marriage given the low wages they received which obliged them to save or work themselves up to higher incomes before creating a family.

A common narrative for reconciling registered women’s work is that the physical strain involved in the new job opportunities —open-cast iron ore mining, transport, dock work, iron and steel factories, ship-building, and other metallurgic transformation industries— made the two-parent breadwinner nuclear family evolved into a male-breadwinner nuclear family unit in which women were increasingly excluded from labour markets. Surely they lost opportunities for contractual economic participation —female contract labour was reserved to single women who could work without restrictions and the demand for these jobs grew less than proportionally to immigration (for ex. services in middle and upper class households). Informal and temporary jobs became more prevalent for married women. Pushed out of contractual labour markets by masculisation of labour markets, in-migrant women conceived marriage as an important survival strategy. But this way married women were forced to provide informal extra income especially during the part of the family life cycle when their children were too small to contribute to family income.[[21]](#footnote-21) The average family size was quite constant in Bilbao and in 1935 was around 4.5; in the metropolitan area between 1920 and 1935 it was near 5.2, so for our contrasts we assume a family composed of mother, father and three children (González Portilla, 1995: 272 & 2001: 403).

Following reports and handbooks on human food and energy requirements, we have calibrated a blast-furnace steel worker’s calorie requirements at 4,000 kcal, women working within the adverse industrializing urban environment with child-bearing and child-rearing, family nutrition, family care and hygiene at 3,000 kcal and an average 2,150 kcal for each of the three children. This gives us a total of 13,450 kcal for the family unit. Male steel workers energy balance is coherent with other references to exceptionally active occupations.[[22]](#footnote-22) We have set the level slightly higher —plus 200 kcal— to compensate for the lower degrees of mechanization at the time we are observing, the higher exposure to heat and piecework bonus schemes.[[23]](#footnote-23)

Energy requirements for women providing for children, water, food, clothing, hygiene, heating material, and home may seem high, but we assume non-contractual work especially for women in the early child-bearing stage of the family life-cycle. Providing food and water, heating, waste disposal, washing, cleaning and child rearing were physically more demanding than what we may register in more recent times or in rural environments.[[24]](#footnote-24) The 2,150 kcal for each of the three children is obtained as an average for infants, children and adolescents between 0 and 18 years, taking into account the different metabolisms in girls and boys and assuming medium-hard physical exercise from age 12 on.[[25]](#footnote-25)

Figure 1 in the publication shows the monthly upper and lower bound cost in pesetas for the five-member blast furnace worker’s family bundle which varies in composition month by month. We have calculated Laspeyres and Paasche type bundles for each month and the bundles shown are a geometric average *á la Fisher*. The prices used for the upper bound are the highest prices registered on the Bilbao market and the lower bound uses the lowest prices. If we look at the best possible scenario first, the lower bound cost-of-living shows a sharp and constant increase throughout the First World War and the immediate post-war years up to 1920, a downward trend between 1921 and 1923 followed by a very gradual increase up to 1930. A second sharp increase is observed between 1930 and 1931, followed by certain stability and a slow decrease between 1932 and 1934, further stability in 1935 and a renewed increase in 1936.

**Discussion of complementary data**

**Poor relief in Bilbao**

The organization of an efficient system of poor relief could have mitigated the positive check between real income and mortality, as Kelly and Ó Gráda have shown for preindustrial England in the 17th century.[[26]](#footnote-26) If the authorities and public institutions had reasons to enforce poor relief in order to prevent social unrest, we would think that the incentives to do so were even greater in a district with a very well-organised working-class movement in the first third of the 20th century. Nonetheless a careful review of what we know about the system of poor relief in Bilbao reveals it as strongly underfunded and laggardly adaptive. The detailed study of the relief system suggests that it had a limited response capacity to overcome situations of extreme distress caused by the sudden drops in real wages, at least up into the 1930s. Self-financing was introduced in some cases.[[27]](#footnote-27)

As other regions in Spain, Bilbao had begun to organize an integrated system of poor relief in the second half of the 18th century. This is when the main indoor institution, the hospice La Santa Casa de Misericordia, which gave a home to children and elderly was created. Once industrialization picked up, other hospices such as the Casa Provincial de Expósitos, supported by the regional government were added. Their statistics show short-term reactions in the number of children abandoned to homes in reaction to sharp falls in real incomes, especially in 1915-1917 and 1930-1932. In the same way, child abandoning fell drastically as incomes increased over the 1920s.[[28]](#footnote-28)

Private and public spending on poor relief channelled into three other lines of action: the creation of sanatoriums and hospitals for the working class, especially to combat tuberculosis; the creation of school canteens to improve child nutrition; and outdoor poor relief. Tuberculosis centres followed the Western European model, a dispensary (1915) in the centre of the city to make a first-hand evaluation of each case and hospitals or sanatoriums for long-run treatment outside the cities.[[29]](#footnote-29) Between 1919 and the mid-1920s, two seaside sanatoriums were completed for children and another in the mountains for adults.[[30]](#footnote-30) The first school canteens were opened in 1912-1913. They offered cheap meals to poor and weak children. By the 1930 they had grown and served meals to some 2.000 children.[[31]](#footnote-31)

Outdoor poor relief was the third tier in the struggle against poverty.[[32]](#footnote-32) This form of relief had a number of advantages. It was cheaper than putting persons into homes and it could be co-financed by the person receiving aid. It was more flexible and responsive to emergency situations. It also increased the perimeter of the area which could be attended to. Bilbao established its outdoor poor relief in 1882, financed by the local town hall. It distributed food rations, milk and coal. The beneficiaries were unemployed or illness-stricken working-class families (Roda, 1931: 153).

The existing institutions (indoor and outdoor) were unable to attend the needs during massive labour conflicts or times of extreme economic strife. Provisional soup kitchens were installed to face the food shortages arising from those situations.[[33]](#footnote-33) Permanent soup kitchens were also promoted and installed by the Asociación Vizcaína de Caridad created in 1903 by Count Aresti, and other philanthropic businessmen.

FIGURE E

Outdoor poor relief: meals served in soup kitchens (Asociación Vizcaína de Caridad) and á domicile (Beneficencia Domiciliaria), compared to real wage



**Tuberculosis**

Tuberculosis is caused by bacteria (Mycobacterium tuberculosis). It spreads from person to person through the air when people with lung tuberculosis cough, sneeze or spit. The contagion rate increases with overcrowding. The risk of being infected is higher for persons with compromised immune systems, those suffering malnutrition, heavy smokers, and people who have suffered alcohol abuse (WHO 2014a: 12 and 2014b: xi & 1).

Over the late 19th century and the beginning of the 20th, the vast majority of tuberculosis cases in Spain occurred in ages between 15 and 35 years. Contemporary doctors attributed falling ill with tuberculosis to insufficient food intake, long working days, living in unhealthy dwellings and alcoholism (Molero Mesa, 2010: 171). The contemporary epidemiological studies carried out in Madrid and Barcelona reported poor living conditions and inadequate diets as the causes of high tuberculosis mortality rates. Vicente Álvarez Rodríguez-Villamil, a pulmonologist and city counsellor, analysed income and spending of average families in Madrid at the beginning of the 20th century and concluded that workers did not have the sufficient intake of calories to keep a balanced state of energy making them especially vulnerable to tuberculosis (Molero Mesa, 2010: 174 & 1989: 202-17).

The risk of transmission was greater during late-winter and early-spring months, when the reduction of ultraviolet light worsened the low levels of accumulated Vitamin D. The predominance of the iron-and-steel industry combined with the estuary being located in a narrow valley perpetuated the accumulation of industrial smog that aggravated this condition. Indoor confinement due to cold weather and frequent rainfall enhanced contagion. This was further aggravated by ill-ventilated and overcrowded working-class housing. This morbidity cocktail was magnified by economic stress i.e. lower real income leading to malnutrition.

FIGURE F.

Seasonality of tuberculosis in Bilbao, Jan 1914 – Dec 1936 (deaths per thousand)



As we can see in Figure G, there was an inverse relation both in annualized trends and lagged peaks-troughs between real wages and tuberculosis death rates, accentuated during strong falls and alleviated during increased in real wages.

The distributed lag regressions show a significant inverse impact of real wage variation with a delay of six months on TB death incidence, similar to the impact on mortality rates. Figure H shows overall lung disease death rates and real wages. In the case of overall lung disease deaths regressions again show significant inverse impacts with lags 5 and 6, exactly as in the case of mortality rates.

FIGURE G

Real wages and annualized monthly tuberculosis death rates (per thousand)



FIGURE H

Real wages and annualized monthly lung disease death rates (per thousand)



**Nuptiality**

Nuptiality rates can supplement for missing data on underemployment and unemployment. Unemployment and underemployment rates as we know them today were not registered over the complete period.[[34]](#footnote-34) A close correlation between nuptiality and unemployment was found by Southall and Gilbert (1996) for England and Wales, and by Kirk (1960) for the interwar period in the United States. Wales, England and the United States were industrial forerunners and also share some common demographic patterns. Outdoor poor-relief, for which we have data and which should be highly correlated with under-employment and unemployment, moves in unison with nuptiality rates.[[35]](#footnote-35) Figure I would identify the episodes of nuptiality (in red) contraction pointing at the prevalence of underemployment and unemployment we do not capture with the movement of real incomes —these show only the changes of income of those fully employed. This is the case in the first half of the 1920s and the beginning of the 1930s, with the difference that the contraction of nuptiality persists throughout the 1930s whereas it recovers in the second half of the 1920s. We could therefore assume that underemployment and unemployment are aggravating the economic stress we are able to measure via changes in real income and energy imbalances.

FIGURE I

Nuptiality rates and real incomes



Figure J shows nuptiality rates and the variation in the number of signed-up unemployed (evolución de la lista de obreros en paro completo inscritos en la Bolsa de Bilbao —data before March 1934 from Bolsa Municipal de Trabajo de Bilbao afterwards from Oficina Local de Colocación Obrera, Etxaniz and Ipiña (2017): tabla 5. These are some of the few data observations we have as an approximation to unemployment in Bilbao for the 1930s. The 12-month moving averages reflect a very nice inverse relation to nuptiality rates.

FIGURE J

Nuptiality rates and variation in signed-up unemployed Bilbao, Jul 1932-Jul 1936



**Theft**

In a previous publication —Houpt and Rojo Cagigal (2014)— we have established the relationship between the interwar economic hardships and theft. Previous literature has found a close correlation between poverty and theft. According to the theoretical work developed by Becker (1968), people resort to crime only if the expected costs of committing the crime are lower than the benefits gained. Those living with less have more to gain and have a much greater inclination to committing theft constrained by their moral thresholds. For the link between economic conditions and crime, see the summary of Johnson (2002: 137-141) for pre-1914 Germany, Bignon et al. (2011) for 19th century France, the work of Mehlum et al. (2006) for 19th century Bavaria and Traxler and Burhop (2010) for Prussia. The latter two show a strong correlation between real wages and crime rates.

Additional support for the economic strife of families in Bilbao over the interwar period would be finding decreases in real family income systematically related to increases in property crime. We showed that property crime showed a high negative relation to lagged real wages. We had found that a decrease in workers’ income is followed by a strong proportional increase in property crime five months later, coinciding with the strongest moment of impact on mortality. At this point of time, desperate situations would lead to desperate solutions. The hypothesis that social disruption in the form of property crime may be driven by short-term variation in earnings as a consequence of price increases cannot be rejected with these results. The significant and strong inverse relation to changes in income levels support the hypothesis that higher incidence of property crime may be codetermined by short-term economic hardship.

FIGURE K

Thefts and real incomes



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1. The time series techniques we will be applying can only be employed when variables of interest follow normal distributions, which means that the chance of observing a value very far from the mean value is close to zero. Sometimes data series show unbounded fluctuation around the mean or with some systematic trend. This unbounded nature of variability in the data is commonly known as non-stationarity. Making the results of our statistical exercise reliable requires making our series stationary. We perform certain transformations on data so that excessive volatile nature of data is contained and is made more suitable for uni- and multivariate analysis. Nelson and Plosser (1982) suggest that most time series have a stochastic trend, ***yt* = *yt-1 +* *ut***. Others have a time trend. Hence if we first difference or detrend, this produces a stationary variable. [↑](#footnote-ref-1)
2. We could not apply the 121 month centered moving average proposed by Lee (1981: 358 and 739). This would have reduced our sample range almost by half. [↑](#footnote-ref-2)
3. We use the same ordering based on their assumptions of recursiveness for the impulse response functions. Nicolini (2007: 107) and Fernihough (2010:18). We have excluded 4 high mortality outliers caused by Spanish influenza August-November 1918 and 8 unusually low nominal income outliers due to strikes or lockouts in December 1916 (strike), January 1917, March-May 1917, August 1917 (strike), and June-July 1922 (end of labour agreement, attempt to cut wages by 20 %). We have used Schwarz [SC] and Hannan-Quinn information criteria [HQ] to determine the lag length. SC indicates one lag and HQ indicates three. We have fitted a two-lag VAR model. The one-lag and three-lag specifications give very similar results. The inverse roots of the autoregressive characteristic polynomial are less than one in absolute value, which indicates that the model is stable. Residuals show some seasonal correlation with BR, normality for DR and W —the variables we are interested in relating. [↑](#footnote-ref-3)
4. A bit over 2 % of the immigrants to the Bilbao Estuary between 1920 and 1935 came from the Navarre province. Gonzalez Portilla (2001, V1: 244). [↑](#footnote-ref-4)
5. González Portilla (2001: 154). Biscay witnessed the highest rate of population growth in Spain between 1860 and 1930, 42 % of that growth can attributed to Bilbao and 39 % to the surrounding municipalities in the Bilbao Estuary. Greater Bilbao grew at rate of 37.8 per thousand p.a. between 1877 and 1900 and 21.1 per thousand p.a. between 1910 and 1930; the industrial suburbs (*Margen Izquierda*) grew at 54.6 and 26.5 per thousand respectively. [↑](#footnote-ref-5)
6. For a detailed discussion of the source we use, see Fernández de Pinedo (1992: 125-26). Today they can be found at Archivo Foral de Vizcaya, signaturas AHV 0295 [1914] to AHV 0310 [1927]. Annual averages for 1928 to 1935 have been taken from Gonzalez Portilla (1984: 74 and 85) (quoted as taken from the libros de cuentas de AHV Ejercicios 1902-1936, Consejo de Administración y Carpeta Financiera). [↑](#footnote-ref-6)
7. The mean factory wage is on average 5,7 % higher than blast furnace worker’s wages with a correlation coefficient of 0.98. Any bias from using the average wages will work against our hypothesis of family vulnerability. [↑](#footnote-ref-7)
8. Linear interpolation has been performed. [↑](#footnote-ref-8)
9. The differences could be interpreted as the more than proportional growth of extra income from premiums and overtime payments. There is definitely a strong discrepancy of the two series for the 1930s. [↑](#footnote-ref-9)
10. Fernández de Pinedo describes the reduction of the wage gap between skilled and unskilled workers as a consequence of the price hikes during the war. Employers were more concerned with increasing the lower wage to a sustainable level and thereby reduced the skill premium. Fernández de Pinedo (1992: 147-8). The six years up to 1928 of this series were extrapolated as a fixed proportion of the average wage as we have no disaggregated data on unskilled labour after 1921. [↑](#footnote-ref-10)
11. The real wage equals the nominal wage divided by the consumer price index. The real wage shows proportional changes and relative levels. It has no absolute interpretation. To make the results more informative, [Allen] compute[s] welfare ratios instead of conventional real wages. The welfare ratio is average annual earnings divided by the cost of a consumption bundle for a family. A welfare ratio greater than one indicates an income above the sustenance line, while a ratio less than one means the family is in poverty. Allen (2001: 424-5). [↑](#footnote-ref-11)
12. This is what distinguishes our index from the Biscay index calculated by Pérez Castroviejo (2006). He has used prices for non-food items taken from the municipal hospital of Bilbao. He uses two sources for food items: the retail prices sent to the Instituto de Reformas Sociales [IRS] and Instituto Geográfico y Catastral, which have survived in the Baracaldo municipal archives, for 1891-1927, and from 1927 to 1936 he uses the same source we use, el *Boletín de la Estadística Municipal de Bilbao*. His housing costs have been extracted from rents paid for housing and offices uses by public civil registries and notaries. Pérez Castroviejo (2006: 105-7) [↑](#footnote-ref-12)
13. This has been complemented with similar sources from an adjoining Baracaldo municipality during a short period when the bulletins were lost or were not published: January 1919 to July 1921 monthly data recollected from Archivo Municipal de Baracaldo and October 1921 to May 1922 monthly data taken from Boletin del Instituto de Reformas Sociales. [↑](#footnote-ref-13)
14. (2.29 - 0.75 kg of potatoes) \* 690 cal = 1,062 cal and (0.45 – 0.14 beans and chickpeas) \* 3,330 cal = 1,032 cal. See Pérez Castroviejo (1992: 146-8) for descriptions of Biscayan working-class diets at the beginning of the 20th century. [↑](#footnote-ref-14)
15. Blast furnaces work 24 hours, 7 days a week during their more-year campaign. They only stop for relining and serious maintenance problems between campaigns. [↑](#footnote-ref-15)
16. The relative weights of each item in the average family basket have been calibrated as described, but taking into account previous studies for the industrial and mining area: Pérez Castroviejo (1992, 2000 and 2006), Pérez Castroviejo y Martínez Mardones (1996), Pérez Fuentes (1993), Pérez Castroviejo and Tussel (2007), Escudero and Pérez Castroviejo (2010). We have also taken into account other recent studies for other regions of Spain (Moreno Lázaro, 2006 for Palencia; Molina de Dios, 2007 for Mallorca and García-Gómez and Escudero (2018) for Alcoy. [↑](#footnote-ref-16)
17. For 01/10/1898 *Lucha de Clase* in Fusi (1975: 56, fn. 81), for 1904 Sanz Escartín, Salillas and Puyol Alonso (1904) *Informe referente a las minas de Vizcaya* and 1907 Solinis “El obrero en Vizcaya.” El Socialista, 9/8/1907 see Pérez Castroviejo (1992: 146). [↑](#footnote-ref-17)
18. Olábarri (1978); “Proyecto de Reglamento Provisional de la cantina que como ensayo se establece por el Excmo. Ayuntamiento de Bilbao en el Grupo escolar de Urazurrutia” (1911), “Cantinas escolares en Bilbao curso 1914-1915”, Archivo Municipal de Bilbao, sección segunda; “Gastos en alimentación del Hospital de Basurto”, 1915, 1916, 1924. Data provided by Juan Gondra. We have scrutinized this is the previously cited work on Biscay and Bilbao. [↑](#footnote-ref-18)
19. González Portilla (2001) and Muñoz Fernández (2019). [↑](#footnote-ref-19)
20. González Portilla (1995: 304). For married women between the age of 15 and 59, data was constructed from municipal registers of population, Bilbao archives. [↑](#footnote-ref-20)
21. 70.8 % of all families were nuclear families in 1900 and 68.4 % in 1930. The average age of marriage in Bilbao rose from 27.4 to 28.3 years of age for men and fell from 27.6 to 25.5 for women between 1825 and 1930 as a consequence of lower incomes for unskilled labour and segmentation and masculinization of labour markets. Fifty per cent of all heads of families were day-labourers. González Portilla (1995: 268-297). [↑](#footnote-ref-21)
22. WHO (1974), *Handbook on Human Nutritional Requirements*, chapter 2, table 2. FAO (2001), Human energy requirements. Chapter 5, tables 5.4 and 5.5. Evidence for Chinese mine and shipbuilding workers for the 1980s confirm this balance. Fernández de Pinedo (1992: 127-28) uses a food bundle equivalent to 4,810 kcal to deflate nominal incomes. [↑](#footnote-ref-22)
23. See Fernández de Pinedo (1992) for a discussion of bonus schemes in AHV the company whose real work earnings we are using in this study. Consolazio et al. (1961) studied the effect of extreme heat on young men exposed to average temperatures of 40º C during 9 hours as opposed to an average daily temperature of 26º C. Extreme heat increased their energy requirements to over 4,000 kcal from 2,733 kcal at a normal temperature. [↑](#footnote-ref-23)
24. Three surviving children may imply an average of 5 pregnancies and up to 4 two-year lactation periods. During the first six month of lactation with exclusive feeding the energy cost was 675 cal. per day and the remaining time with partial feeding 460 cal. See FAO (2001), chapter on energy requirements during lactation, p. 65. Pregnancy consumes 85 cal./day, 285 cal./day and 475 cal./day during the first, second and third trimesters respectively. See FAO (2001), chapter on energy requirements during pregnancy. At a 5-year fertility cycle women would require an average of 250 kcal. per day more for pregnancy and lactation. This has been distributed between mothers and children surviving from 0 – 2 years of age. [↑](#footnote-ref-24)
25. Averages calculated from WHO (1974). Schneider (2013a: 101) FAO averages 2,075 kcal and Humphries et al. (2021) Online Appendix Table S4 averages 1,877 kcal. [↑](#footnote-ref-25)
26. They show that the implementation of a system of poor rates and the growth of Poor Law expenditure significantly reduced the impact of living standards on death rates around the 1620s. Kelly and Ó Gráda (2010: 23-24). [↑](#footnote-ref-26)
27. The Santa Casa de Misericordia and the Hospital de Basurto administered the municipal bull ring, whose income financed a part of its activities. The administrative costs (10%-30% of their expenditures) were progressively assumed by the two local savings banks. Lindert (1998: 121). The municipal savings bank assumed the administration of the infant clinic Niños de Pecho y Gota de Leche, of the tuberculosis seaside sanatorium in Gorliz, and the Beneficencia Domiciliaria organized by the Bilbao municipality, among others. [↑](#footnote-ref-27)
28. The other two institutions are the Elderly Home, created around 1880; the Orphanage, supported by the town hall, both of which were attended to by nuns. Roda (1931). [↑](#footnote-ref-28)
29. Molero-Mesa (2001: 39-40). [↑](#footnote-ref-29)
30. Roda (1931). [↑](#footnote-ref-30)
31. Aranceta (2010: 83-100). [↑](#footnote-ref-31)
32. This was the model adopted in England and Wales in the nineteenth century, in contrast to France, which preferred indoor institutions. Lindert (1998: 120-121). [↑](#footnote-ref-32)
33. Between 1893 and 1895 they installed soup kitchens in January and February because of the bad weather. In March of 1898 they installed a soup kitchen because of a mining strike. Aranceta (2010). [↑](#footnote-ref-33)
34. Etxaniz and Ipiña (2017) do provide the number of union workers signed up for the municipal job pool for the 1930s. We will examine their variation with nuptiality further ahead. [↑](#footnote-ref-34)
35. Friedlander found that from 1855 to 1901 in England and Wales for each unemployment peak in a given year there was a trough in the marriage rate and vice versa. His regression analysis confirmed that the change in unemployment levels explained nearly 50% of the variance in marriage rates (Friedlander 1992: 32-33). Kirk (1960) also found an inverse correlation between unemployment and nuptiality for the United States, stronger during the interwar period than after the second world war (Kirk 1960). [↑](#footnote-ref-35)