SUSTENANCE AND STRIFE. STANDARDS OF LIVING AND FAMILY VULNERABILITY DURING SPAIN'S INDUSTRIALISATION. THE BILBAO ESTUARY, 1914-1935

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ABSTRACT

Did industrialisation improve standards of living in interwar industrial Spain? We seek to contrast this empirically with high frequency data from 1914 until 1936 for the Bilbao area, an emerging industrial centre. Contrary to existing historiography suggesting that overall standards of living improved, we find that welfare ratios remained at the same level and, at times, fluctuated significantly below sustenance levels. Demographic and socioeconomic variables were highly responsive to short-term real wage shocks driven by food price increases and the delay in nominal wage increases. Interwar industrialisation provided improvements, but did not provide protection from recurring deprivations and these may have constituted an important part of future political and socioeconomic polarisation and violence.

Keywords: standards of living, Spain, industrialisation, mortality, family vulnerability

JEL Classification: N34, N93

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RESUMEN

¿Mejoró la industrialización el nivel de vida en la España industrial de entreguerras? Buscamos contrastar esto empíricamente con datos de alta frecuencia entre 1914 y 1936 para la Ría de Bilbao, un centro industrial emergente. A diferencia de la historiografía existente que sugiere que los niveles de vida en general mejoraron, observamos que las ratios de bienestar se mantuvieron en el tiempo y, en ocasiones, fluctuaron significativamente por debajo de los niveles de sustento. Las variables demográficas y socioeconómicas respondieron en gran medida a las perturbaciones de los salarios reales a corto plazo provocadas por los aumentos de los precios de los alimentos y el retraso en el ajuste de los salarios nominales. La industrialización de entreguerras proporcionó mejoras, pero no proporcionó protección contra las privaciones recurrentes y esto puede haber constituido una parte importante de la futura polarización y violencia política y socioeconómica.

Palabras clave: niveles de vida, España, industrialisación, mortalidad, vulnerabilidad familiar

1. INTRODUCTION

Did industrialisation improve standards of living in interwar industrial Spain? Our analysis assesses the case of urban living standards in one of the emerging industrial areas in northern Spain over the first third of the 20th century. We focus on an industrial enclave, the area surrounding the Bilbao estuary. Bilbao moved forward strongly as an up-and-coming industrial centre in Spain in the later decades of the 19th century, consolidating its position in the first third of the 20th century. Its initial momentum came from iron ore exports to Great Britain, Germany, Belgium and France combined with its long tradition as Spain's major Atlantic port. It went on to establish an important iron and steel industry, and over the first two decades of the 20th century, it diversified into downstream activities such as shipbuilding, machine building, railroad equipment, mechanical engineering and other metallurgical and capital goods industries. Immigration into the industrial centre was intense during the export mining boom, drawing excess agricultural labour from beyond the immediate hinterland—the surrounding provinces—very much as had occurred in other northern European industrial regions throughout the 19th century (González Portilla 2001, pp. 165-284; González Portilla and Urrikoetxea Lizarraga 2017, pp. 39-40). A large amount of early capital for infrastructures was provided by British foreign investment, and additional capital for industrial take-off was made

available by reinvested direct and indirect mining profits, but foremost by local and national investors (Flinn 1952, 1955; Valdaliso 1993). The expanding global economy and modest Spanish economic growth in the early 20th century provided markets and factors for rapid growth.

Spanish historiography has sought to identify the very slow improvement in living standards during the interwar period as one of the causes or aggravating circumstances that led to the Spanish Civil War[1]. More recent Spanish research sustains the view that material conditions and equality in Spain improved over the interwar period[2]. According to this newer literature, improvement occurred in swings and spurts. A possible explanation for this can be found in labour theory, which attributes cycles in real wages to changes in workers' leverage. High real wages were extracted during economic boom upswings. However, when economic perspectives worsened, the play of forces changed and money wages adjusted upward more slowly than prices, leading to real income contractions. In Spain, labour relation dynamics were altered from the mid-1920s throughout the 1930s up to the Spanish Civil War, as both the Primo dictatorship and the Republican regime pushed hard to enforce state supervised collective bargaining in an attempt to take the pro-cyclical pattern out of wage demands and employer concessions to reduce economic distress, unsustainable labour costs and social violence, which had given growing political franchise to radical parties and organisations in the interwar political scenario.

We have assembled an exceptional database to contrast the stylised facts and conclusions many of these economic historians have sustained over decades. Our working hypothesis is that in the emerging industrial area of Bilbao, real incomes sporadically suffered strong downward fluctuations and, overall, did not improve substantially during the period. We are convinced that there were recurring shocks to real family incomes, exposing their vulnerable and precarious living conditions. We base our analysis on the detailed examination of the impact of short-term variations in prices and real incomes on vital statistics and on other indicators of socioeconomic distress.

The article is organised according to a classical presentation structure. The next section provides a review of the recent innovations in data

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[1] For Biscay, see differing views in Olábarri (1978, p. 502), who calculates real wages decreasing 4-8 per cent from 1914 to 1920, situating 12-17 points above the 1914 level by 1925 and reaching an increase of more than 40 points by 1930. Tuñón de Lara (1972, pp. 564, 756 and 824) finds that real wages decreased by more than 21 per cent in iron and steel during WWI up to 1920, then went on to increase by 12 per cent by 1925 and remained constant up to 1930 and then on to 1936.

[2] Over the interwar period, Prados de la Escosura (2008, pp. 288, 306-307) computes a 2.8 per cent annual growth in GDP per capita in the 1920s; Vilar Rodríguez (2004, pp. 124-125) calculates a 30 per cent increase in deflated industrial wages; and Silvestre Rodríguez (2005) finds that the urban-rural wage differences drew land labourers to the cities in quest of a better living.

collection, data analysis and methods related to measuring standards of living. In section three, we present the data for the analysis of the Bilbao case study and the previously covered innovations we would like to implement. It also presents complementary socioeconomic indicators and puts them into perspective with real income variations. Section four reports on the statistical methods applied in answering the basic question of betterment of living standards and discusses the results, and the final section concludes.

2. STANDARDS OF LIVING AND SHORT-TERM ECONOMIC STRESS

The mother of all standards of living debates—the issue of worker improvements during the British Industrial Revolution—continues to constitute the reference literature for studies on life betterment during industrialisation. Taylor (1975) outlined the state of the question almost 50 years ago. Since then, the ongoing dispute between optimists and pessimists on living standard improvements during the British Industrial Revolution has been enriched in a number of ways. New and better data have been one strategy, with important macroeconomic recalculations by Feinstein (1995, 1998), Crafts and Mills (1994) and Crafts (2007). With the new data, Voth (2003) stressed that stagnant wages and stationary well-being were no longer at variance, with the overwhelming evidence that the growth of output and productivity were slow during the Industrial Revolution.

Robert Allen (2001) put the British case into perspective and re-opened a key debate on long-run international living-standard comparisons introducing poverty lines in the form of bare-bone and respectability baskets and welfare ratios (Allen 2007, 2009). His use of male wages in professions with widely available data and uniform consumption baskets across time and space has set off academic debate (Humphries 2013; Hatcher and Stephenson 2018; Humphries and Weisdorf 2019; Horrell *et al.* 2022). In any case, respectability baskets, welfare ratios and sensitivity checks, both for «bridging lacking data» assumptions and weak data, are still important approaches.

The reassessments culminating in Humphries and Weisdorf (2019) based on collecting annual workers' incomes rather than annualised day-wage rates suggest that real wages have been underestimated during the Industrial Revolution. Horrell *et al.* (2022) have made further contributions to correctly assessing family income by providing new data on women's and children's participation. Other work has calibrated the varying family life-cycle needs and earnings which impose a U-shape on families' ability to make ends meet by considering different family types—alternative to the male breadwinner family model—which help better understand the variety

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of situations working populations lived in (Schneider 2013b; Boter 2020; Horrell *et al*. 2022). All in all, new and more comprehensive data and alternative models are providing important new insights.

Real income analysis remains the workhorse for standard-of-living analysis and many of the cited advances could be classified as responding to the research agenda set by Scholliers (1989). In order to advance in the adequate interpretation of real wages, he identified six venues of necessary improvements: (i) the need to provide effective income from all family members rather than basic individual male wages; (ii) family life-cycles need to be taken into account for accurate measurement of betterment; (iii) retail prices rather than wholesale prices should be used when constructing consumption basket deflators—especially in short-term analysis; (iv) underemployment, unemployment and work frequency need to be carefully calibrated—annual income or over-the-year incomes should be preferred; (v) non-monetary and non-wage earnings should be included in family incomes; (vi) and the on-going changes in family consumption and spending patterns should be taken into account (Scholliers 1989, pp. 1-19 and 229-235).

Complementary evidence has been provided by anthropometric studies and analyses of vital statistics and investment in human capital in the highly urban and industrial layers of the working population. Other sources of improvement also need to be considered. Kelly and Ó Gráda (2010) and Szreter (1997) both suggest that the key to reversing deteriorating living conditions were charities and public health institutions.

Analogously, standard-of-living analysis had received important new directions by examining how vital statistics react to short-term economic stress (Lee 1981, 1985; Richards 1983; Galloway 1985; Hammel 1985; Eckstein *et al*. 1986, 1988; Hagnell 1991; Palloni *et al*. 1996, 1993; Lee and Anderson 2002; Weir 1984). Reher and Sanz-Gimeno (2000), Bengtsson (2004) and Bengtsson and Dribe (2005) refined this further by studying the effect of short-term economic variations on populations in economic and structural transitions. In Sweden, during such moments of transition mortality, fertility, nuptiality and migration were all affected by variations in prices in times of severe famines, but surprisingly also due to smaller changes in prices and incomes. More interestingly, Spain has shown strong evidence for the persistent effects of economic fluctuations on mortality rates, especially for the period we propose to examine. With these and other studies, vulnerability to short-term economic shocks has come to be considered a complementary way of measuring standards of living.

We will apply a number of these innovations to our question of betterment of standards of living in industrializing urban Bilbao. What makes the Bilbao estuary an interesting «natural» experiment for understanding the process of industrialisation and its impact on standards of living is

its speed and scale. Together with Catalonia, Biscay was a Spanish industrial forerunner and the only other province on the Iberian Peninsula where the percentage of labour employed in agriculture was less than 50 per cent before the beginning of the 20th century. Biscay gained higher access to Spanish markets in 1841 when customs boundaries were shifted from its borders with the rest of Spain to its coast, that is, it became part of the Spain's «common market». The 1869 liberalisation of mining and commerce opened its vast haematite iron ore resources to international markets and foreign investors, such as Great Britain, Belgium, France and Germany. Trade with European iron and steel centres established bridges for the transfer of technical equipment and skills (Fernández de Pinedo 1983; Perez Castroviejo 1992, pp. 168-174; Houpt and Rojo Cagigal 2006).

Our research uses monthly data to offer two innovative contributions to the debate on changes in living standards during industrialisation. First, it refines the *analysis of family vulnerability by adding the changes in caloric energy balances to those in prices or wages*. We examine the calorie purchasing power of family incomes with their energy requirements in a high-calorie high-wage economy. Second, it proposes a different approach to contrasting the evolution of living conditions. We look at population as a whole, primarily focusing on *how families rather than individual workers responded to economic shocks*, that is, we «measure the [families'] standard of living by the ability to overcome short-term economic stress. If one cannot fulfil one's long-term plans […] in the face of acute short-term changes in the environment, one can be said to have a rather low level standard of living» (Bengtsson and Dribe 2005, p. 350). We measure worsening standards of living in terms of acute family vulnerability.

Our assumption is that in an industrialising urban environment, smoothing out these short-term fluctuations was much more difficult than with previously lower urban densities and extensive surrounding rural areas. Widespread family networks, common lands for supplementary foods or land as security for borrowing were not available in an urban setting[3]. Hobsbawm insists on urban industrialisation's contribution to providing more regular consumption—not necessarily higher net consumption—and smoothing out consumption cycles (Hobsbawm 1957, p. 46). This could explain an overall improvement in living standards compatible with high degrees of vulnerability to economic stress.

In parallel, due to the continuous inflow of labour pushed out by the agrarian crises, transformations and decline of traditional sectors and pulled into the city by more regular incomes and job security, urban workers were confronted with an ever-advancing host of incoming workers

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[3] See also Fernández de Pinedo (1992, p. 149), who insists that the nuclear male breadwinner families settling in the new industrial city by migration were deprived of «a cushion» for hard times, which was the extensive family typically present in rural areas.

willing to take their jobs at the nominal wage imposed[4]. Revealed in-migration—increase of population above natural growth—averaged around 170 a month for most of World War I, rose to an average 390 up to 1922, peaked at 1,400 in 1923, returned to 450 for the rest of the 1920s, and came back down to 350 for the first half of the 1930s. Strong flows of in-migrants did not coincide with strong downturns in the welfare ratios or social strife indicators, rather changes in in-migration seemed to respond inversely to their movement.

Without land collaterals, rural migrants had fewer means of smoothing out the effect of price shocks on consumption. They were cut off from the money wage complements found in rural areas—commons—and more detached from extensive rural family networks and long-term agricultural employers, who could have supported them through hard times. The conjuncture of these circumstances had the potential for deprivation, even for falling below sustenance levels.

Even so, we know that having an important part of population live on the edge was not viable over a long period. Strong social unrest in the context of an all-too-slow process of betterment inevitably forced living conditions to be improved over the course of the 20th century. Therefore, the standard-of-living debate today is not so much about *whether* the Industrial Revolution ended up making people better off, but rather about *when* it made people better off. We come to agree that urban disamenities, including higher vulnerability during downturns, offset many gains in well-being attributable to rising real wages during industrialisation. Although for most practical purposes real income per person remains the most telling indicator accounting for changes in standards of living, we should and will attempt to capture other dimensions of well-being in the analysis to follow (Nardinelli 2010). The curses and blessings of industrialisation are not up for discussion, but their timing and interaction are of great interest in view of the social and political turmoil which is contemporaneous to the period we examine here.

3. MEASURING STRESS AND VULNERABILITY

A few words need to be said to explain why we choose families as consumption and production units in our comparisons. Our workhorse for the analysis is a male-wage breadwinner family which relies mostly on the wages collected from *Altos Hornos de Vizcaya*, the biggest iron-and-steel

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[4] For the segmentation of migration patterns to the Bilbao estuary, see García Abad *et al.* (2011), González Portilla and García Abad (2008), González Portilla and Urrikoetxea Lizarraga (2017); and for the forces pushing out-migration from the rural areas of Northern Castile and the north Atlantic regions, see Robledo (1988, 2010), Sánchez Alonso (2000), Silvestre (2005) and Carmona *et al.* (2018).

concern in Biscay, and in Spain. 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 the high-effort nominal wages can buy in terms of the high-energy basket required will tell us when the family is over or under its energy level. Our assumption, of course, is that other families' baskets and wages moved proportionally—nominal wages reflect energy effort in a high-energy setting (e.g. loading and unloading at docks, open-cast mining, transport, iron and steel mills, ship-building, metallurgic trade). Therefore, when our workhorse nominal wage moves below the nominal price of the family energy basket, we presume that all families move closer to energy sustenance levels. We are interested in seeing this energy balance as a thermometer of family well-being or family stress.

Putting family households into short-term economic stress analysis implies accounting for both sides of the energy balance, energy required and energy acquired. We can calibrate the energy requirements fairly well using present day standards relying on FAO food requirement documents. Our calibrations are very similar to those Schneider (2013a) devised for Great Britain up to World War I. A description of the assumptions and exact amounts calibrated can be found in the online appendix.

A far more challenging issue is including the income of all family members. Demographic studies for Bilbao are showing an increasingly predominant male-wage-earner family model. The contributions of women and children to family income progressively became more oriented to non-contractual, informal or part-time work over the period being examined. A reasonable approximation to female and child work opportunities is to scrutinise evidence brought forward during early industrialisation in the adjacent mining districts, which has been studied in more detail. This is where massive immigration and families struggling against low incomes and overcrowding first evolved. We know that low-income families complemented low male salaries by agricultural tasks in vegetable plots, animal husbandry, food-mongering, supplying water and firewood for homes, or washing and mending others' clothes. However, the most important source of additional income was boarding other miners, providing them with bed, food preparation, washing, sewing and cleaning. Complementing low male salaries was especially prevalent when children were not contributing to family income (mothers between the ages of 20 and 35 and again between 45 and 59) and when seasonal migration in mining increased demand for temporary accommodation. (García Abad 2005, pp. 191-193; García Abad 2010, p. 78; García Abad and Ruzafa Ortega 2009, pp. 33-43). Detailed analysis based on an industrial tax-related enquiry for Bilbao in 1895 has revealed an important invisibilisation of women's work in municipal registers

(Pareja Alonso 2011)[5]. For the moment, we will work with real male family income only. Income from other family members is a concern we will go on to address further in the discussion of results section.

When confronting the blast-furnace worker family's cost of living with the nominal earnings for a worker at the biggest iron and steel concern in Bilbao, *Altos Hornos de Vizcaya*, we observe an interesting coincidence. Labour conflicts, measured here by the number of strikes in Bilbao, coincide with moments in which nominal earnings move towards the lower bound cost of living, that is, they can barely buy their energy basket. Conflict reacts even more vehemently when nominal family income falls below the lowest feasible cost of the family bundle, that is, when families are unable to pay for the bundle. This is the case in 1917, the year of the revolutionary general strike but also during the 1919-20 strikes when nominal earnings again came close to our energy lower bound and briefly in 1922 when employers tried to adjust nominal wages back to pre-war levels. At the same time, labour disputes disappear as earnings situate above maximum feasible costs of living until the late 1920s. The decrease in total earnings between 1929 and 1931 is again correlated with increasing conflicts. If we extrapolate this to the proportional nominal earnings-consumption bundles and energy balances of other families during the interwar period, families that had adopted a male-wage-based family model suffered numerous occasions when their families moved close to and below the energy sustenance level, and these occasions coincide with moments of social unrest as expressed by the number of labour conflicts. We have assessed this relationship between relative deprivation and labour conflict in a previous publication (Houpt and Rojo Cagigal 2014).

The analysis we present here turns back to the question of family vulnerability itself. Our appraisal of life betterment is based on very detailed data series proceeding from single sources, both for the cost of living and for nominal incomes: the monthly statistical bulletin for Bilbao and monthly cost accounting from *Altos Hornos de Vizcaya* (see online data appendix for a detailed description). The monthly data introduce a much higher frequency and seasonality than the annual data analysis performed by Reher and Sanz Gimeno (2000) for towns in central Spain and all of Spain and offer important insights when measuring impacts.

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[5] Based on municipal registration statistics, the masculinisation of the active population took place in the Bilbao estuary between 1920 and 1935. In that period, in Baracaldo only 1.7 per cent of the registered native active population were women, and 6 per cent of the registered immigrant active population (González Portilla 2009, pp. 409, table 9.6). In more economically diversified cities such as Bilbao, Guecho or Portugalete, female participation in employment was greater, although domestic service of single women predominated as a registered female profession (González Portilla 2009, pp. 412-413).

Studies on energy requirements in present-day agricultural environments have shown that during high workload seasons, land workers consistently consume more energy than they take in. This is sustainable during short intervals of time, such as ploughing and sowing, and harvest, but energy reserves must be built up again during less busy seasons of the year. Factory work does not allow for such inter-annual energy compensation or smoothing. Energy requirements are constant year-round, and workers and their families are vulnerable to sudden falls in real income, even over very short periods. Monthly data may capture this much better than annual variations. As we will see, families could, to some degree, compensate for sudden falls by pawning or having the remaining members of the family consume less. However, over a span of months, a lack of nutrition would have negative effects on some of the family's health. If family members consumed less energy than they expended during these dire straits, we would expect their resistance to disease to decrease and infant and child mortality, in particular, to increase.

A further advantage of this study is that it concentrates on a small geographic area in which the process of industrialisation took place in quite an isolated form. We use the monthly statistics for the municipality of Bilbao and the extended Bilbao metropolitan area for comparisons and data complementing[6]. There were no competing industrial *loci* within a reasonable distance. The closest comparable industrial centre was in Barcelona, some 600 km away. As Spain's main Atlantic port, the Bilbao metropolitan area had well-integrated commodity markets, and as a consequence of the late 19th century iron ore mining boom, it had a well-functioning labour market. We are in an integrated market context. When making assumptions about which data series to use, we have also taken great care to bias the data used against our hypothesis of recurrent insufficiencies in energy sustenance levels. We have chosen the income data from the highest-paying factory—Baracaldo—of the leading iron and steel company, *Altos Hornos de Vizcaya*[7]. We have used blast furnace workers' income, that is, medium-skilled workers instead of unskilled workers' earnings (Figure 1).

Figure 2 shows that the situation of an unskilled loader's family is much more acute. Before examining this and additional indications of economic strife, we can formulate a preliminary postulate: workers' escape from hunger during early 20th-century Spanish industrialisation is highly

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[6] The Bilbao municipality included the following districts until 1925: Casas Consistoriales, Santiago, Achuri, Bilbao La Vieja, San Francisco, Cortes, Estación, Gran Vía, San Vicente and Hospital. After 1925 Begoña and Deusto were added.

[7] Fernández de Pinedo (1992, p. 140). Sestao paid between 20 and 6 per cent less between 1901 and 1927.

FIGURE 1

EQUIVALENT BLAST FURNACE-WORKER FAMILY, BILBAO 1914-36. UPPER AND
LOWER BOUND COST OF LIVING VS. DAY-LABOUR EARNINGS AT ALTOS
HORNOS DE VIZCAYA AND NUMBER OF STRIKES THROUGHOUT THE PERIOD.
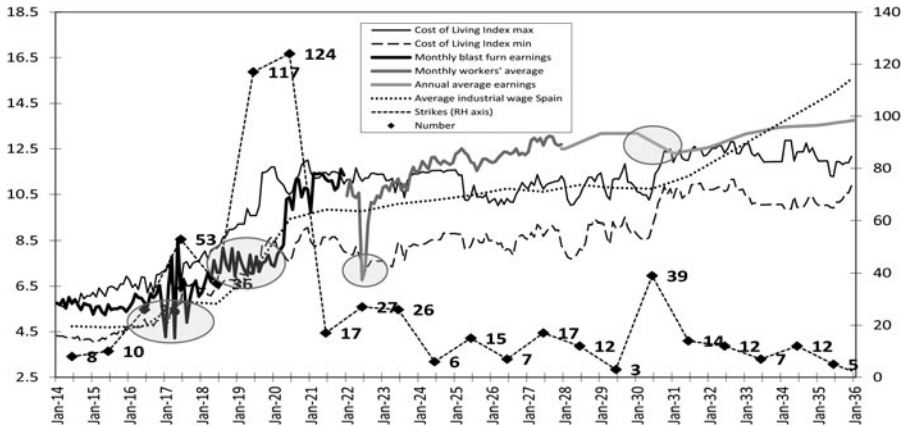
Sources: AHV wages and costs of living: see online appendix; strikes: IRS; and average Spanish industrial wage: Vilar Rodríguez (2004).

questionable even for its highest paid workers. We can illustrate this for the period we are examining by calculating welfare ratios (average monthly earnings divided by the cost of the family consumption bundle), as introduced by Allen (2001). Our consumption bundle has been calibrated to provide the necessary energy nutrition to families. Values below one will show when families are below nutritional energy balance[8]. Even if we were doubtful as to their absolute level interpretation, it is still a «peculiarly scaled real wage index» which reveals evolution over time.

As can be seen in Figure 3, living conditions, measured by comparing monthly family consumption baskets with male nominal wages, worsened between January 1914 and December 1919, improved from January 1920 to April 1930, and then worsened again until August 1932. By May 1935, they had recovered to the levels attained in the mid-1920s. Some of these results are surprising, while others are expected. Perhaps the biggest surprise is that welfare ratios are more or less at the same level in late 1935 as they were at the beginning of 1914. War and post-war economies deteriorated living conditions. In light of the differences with the findings of previous studies, we will re-examine these preliminary results by means of conventional

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[8] The average daily income was multiplied by 300 working days (Perez Castroviejo 1992, p. 186) and divided by the daily cost of the family consumption bundle multiplied by 365.

FIGURE 2
ALTOS HORNOS DE VIZCAYA WORKERS. SKILLED VS. UNSKILLED LABOUR.
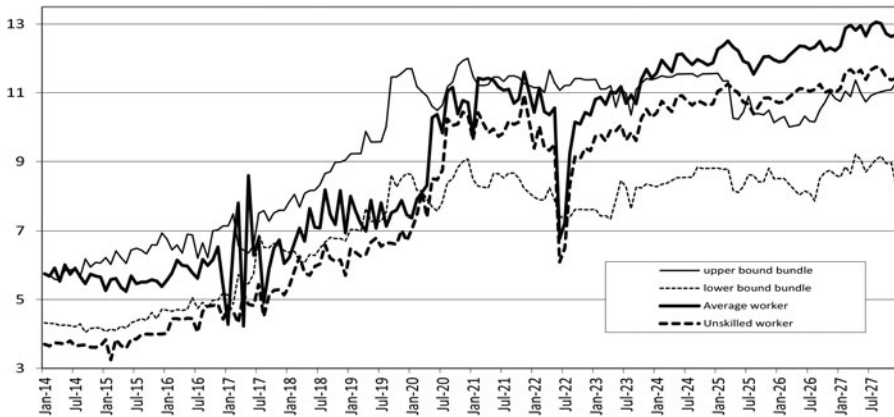
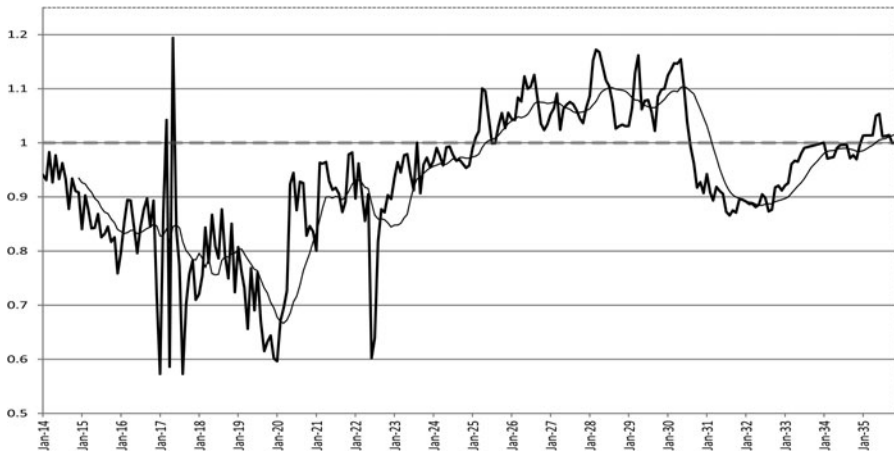*Sources*: AHV wages and costs of living: see online appendix.

statistical analysis and will combine these results with additional evidence to determine whether these findings may be considered robust and coherent.

We have a battery of social indicators that reveal economic stress and vulnerability. We can compare changes in workers' real incomes to the evolution of overall mortality, infant and child mortality, nuptiality, pawns, meals served in soup kitchens, child abandonment, the prevalence of tuberculosis and petty theft. A visual examination can help identify and calibrate co-movements that indicate covariation. Further analysis with standard statistical tools will identify the possible existence of positive checks, that is, vital statistics reactions to real wage fluctuations; the correlation of real wage variations and changes in social distress alleviators, for example, free meals from charities and child abandonment; and the reaction of tuberculosis—a disease highly sensitive to undernutrition, especially in areas of high air pollution and lack of sunlight—to oscillations in real family income.

The monthly mortality rates we use in our analysis are based on the detailed series of burials collected by Juan Gondra. The Bilbao cemetery was moved from Mallona to Derio at the beginning of the century[9]. Figure 4 shows mortality and real income over the first third of the century.

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[9] We prefer the burial statistics to the death registers in the municipal statistics bulletins as they are biased to more permanent residents and the social strata unable to bury their families in their place of origin in the case of immigrants. As a robustness check, we have also collected the municipal statistics death count. The correlation coefficient is 0.985. All contrasts run with the alternative municipal death rate series show the same signs, magnitudes and significances for coefficients. It makes no difference in terms of results and their interpretation.

WELFARE RATIOS FOR AHV IRON AND STEEL WORKER FAMILIES, 1914-1936.

*Sources*: AHV wages and costs of living: see online appendix.

Even though we observe the downward trend in mortality predicted by demographic modernisation, we can observe both phases of reversion and a strong lagged correlation between the series both in their moving average trends and in the inter-monthly fluctuations[10]. The strong relationship between the two variables may reflect a high sensitivity of mortality to changes in real income. This would be the case if important parts of the population lived near energy sustenance levels.

Overall mortality, but also child mortality from age 1 to 5 (Figure 5) and infant mortality (Figure 6), all follow a downward trend over the first third of the century[11]. This endorses the view of demographers on demographic transition promoted by improved sanitary education, public health and water supply and the gradual abatement of infectious diseases starting in cities (Reher 2001). However, in this context and for all death statistics, we see a strong lagged co-movement with real wage levels both in trends and fluctuations, especially during the war and immediate post-war period and the coming of the Second Republic in the early 1930s. Specifically, in the case of child mortality rates, Reher and Sanz-Gimeno (2000),

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[10] González Ugarte (1994, p. 40) registered mortality rates for Baracaldo in 1902 (30.5 per mille), in 1920 (19.1 per mille) and in 1930 (12.2 per mille); and for Sestao in 1900 (28.9 per mille), in 1920 (21.5 per mille, and in 1930 (11.5 per mille). Our annualised data for Bilbao in 1920 (22.2 per mille) and 1930 (13.6 per mille) compare well to that.

[11] Our annualised averages are very much in line with those reported by Arbaiza (1995) and González Portilla (2001, pp. 214 and 237) calculated with census data and civil and church registers.

FIGURE 4
MORTALITY [PER MILLE—LHS SCALE] VS. REAL WAGES [PESETAS—RHS].
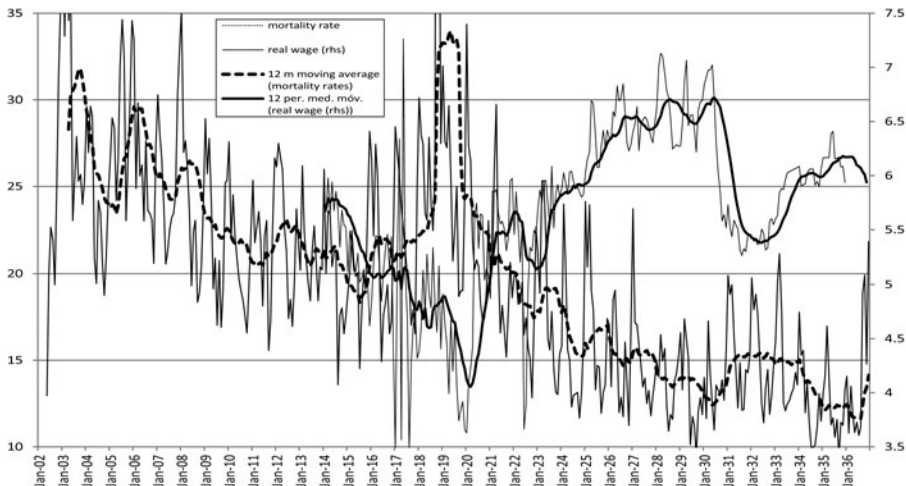
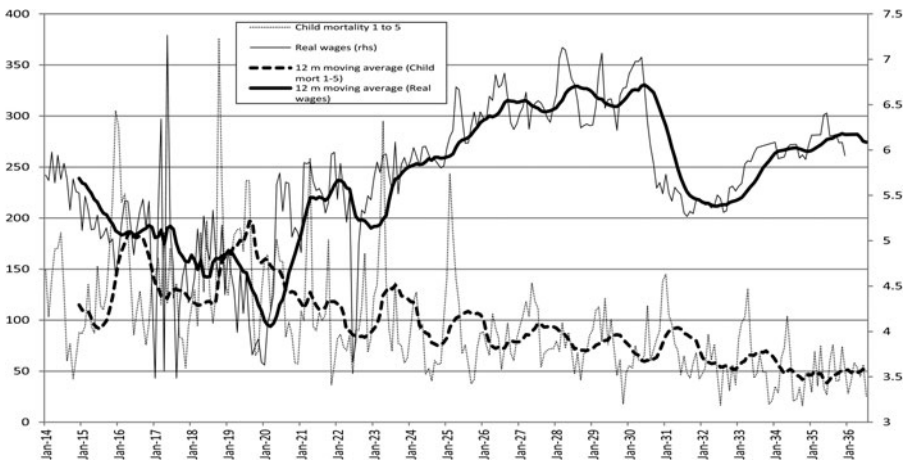*Sources*: wages, costs of living and mortality rates: see online appendix.
Note: The unusually high mortality rate of 92 per mille in October 1918 is off the graph. It was due to Spanish influenza, whose second wave hit Bilbao hardest in October (675 deaths and 803 burials) and November (320 flu victims and 408 burials). Erkoreka (2006).

Bengtsson and Ohlsson (1985), Bengtsson (1999) and Alter and Oris (1997) found this pattern in Spain, Sweden and Belgium and in the latter cases attributed it to small children being at the bottom of the food chain. Looking at infant mortality and real income, we also confirm the coherence of the impact of real income shocks[12].

A child and infant mortality response to short-term economic shocks would be indicative of an inability to smooth consumption—bad access to credit, badly funded poor relief institutions, food-adjusted wages close to sustenance levels (Bengtsson 2004) or exposure of poor relief institutions to economic fluctuations (Reher and Sanz-Gimeno 2000). Although studies of rural areas have found a weakening of this association over time due to higher market integration (smoothing the impact of local bad harvests), in the late 19th and early 20th centuries fast-growing cities had more hostile disease environments due to higher population densities

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[12] González Ugarte (1994) calculates infant mortality for Baracaldo in 1910-1914 at (136.6 per mille), in 1919-1921 at (148 per mille) and in 1928-1932 at (101.1 per mille) and for Sestao in 1900-1909 at (147.4 per mille), in 1910-1914 at (141.7 per mille), in 1919-1921 at (133.9 per cent) and in 1928-1932 at (68.6 per mille). Our data for 1914 at (138.2 per mille), 1919-1921 at (152.4 per mille) and 1928-1932 at (93.4 per mille) match well.

FIGURE 5
CHILD MORTALITY RATE [PER MILLE LHS] (1 < AGE<5) AND REAL WAGE
[PTAS—RHS], 1914-1935.

Sources: wages, costs of living and child mortality: see online appendix.

and overcrowding. A contraction of nutrition could easily increase the lethality of the most common infectious diseases among children and infants (e.g. typhoid, dysentery, enteritis, tuberculosis, smallpox, measles and pertussis), which were strongly influenced by malnutrition (Molitoris and Dribe 2016, p. 177). In microstudies we have found that predominantly working-class parts of Bilbao (San Francisco and Cortes) have much higher mortality rates, compared to predominantly middle-class parts (Gran Vía and Abando); on average there was a 30–50 per cent mortality rate cleavage.

Further evidence on economic struggle can be provided by the anticipated family strategies for facing strife. The first such indicator we examine is pawning—specifically the number of clothing items turned in as collateral for small loans. This is one of the few options poorer income groups have to adjust to a sudden fall in their food provisions. Again, we observe a co-movement in trends and a lagged reaction of pawns to falls and rises of real income (Figure 7). As real incomes fall during and after World War I, pawning steadily picks up; this is followed by the rise in real incomes in the 1920s, which reduces pawning. As strong fluctuations affected real income again after 1927, pawning activity was reactivated. The steady fall of real income in 1930 and 1931 drove the number of pawns up substantially. Pawning clothes was a strategy we would expect of working-class families which were not able to make ends meet all the way into the 1930s. The

FIGURE 6
INFANT MORTALITY AND REAL WAGES.
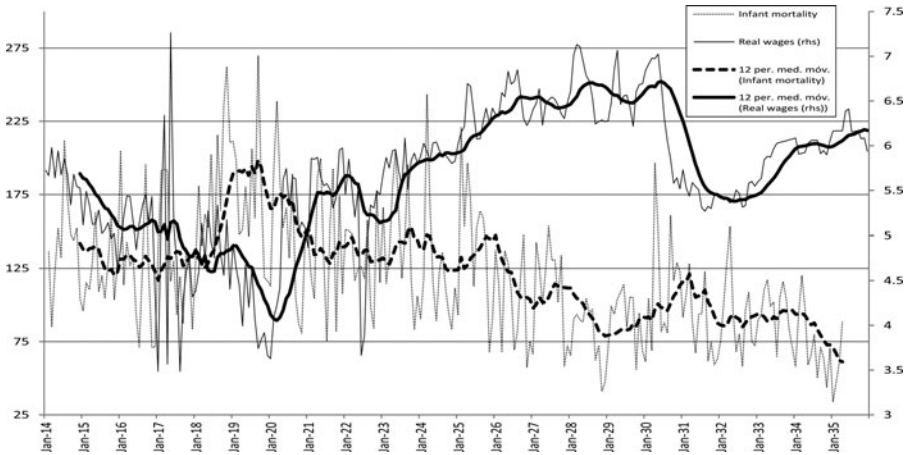
Sources: wages, costs of living and infant mortality: see online appendix.

number of pawns in the early 1930s was near the levels of 1923-1925; at both moments, real incomes were at 1914 levels. Child abandonment is an additional indicator of economic strife (Figure 8). Again, we find strong indications of an inverse relation between cumulative decreases in real family income and peaks in child abandonment.

The monthly series of meals served by outdoor and indoor charity institutions follow similar trends, with higher numbers in 1915-1919 and 1931-1933 and lower numbers in the 1920s, when real incomes are situated above the cost of the consumption bundle (see online appendix, section «Poor relief in Bilbao»). In moments of extreme necessity, as when real income fell drastically during World War I, the number of meals failed to follow needs. We can see a threshold determined by its budget constraint and the constricting increase of prices[13]. This changed by 1931-1933, when meal rations responded with more outside financial support to the strong increase in unemployment suffered as a consequence of the world economic crisis and political instability in Spain[14].

An additional indicator of nutritional stress is the incidence of tuberculosis and other lung diseases. The online appendix shows the data we have

[13] The annual number of meals served by the *Asociación Vizcaína de Caridad* during 1905-1906 was 500,000 (Aranceta 2010, p. 82), whereas during 1914-1918 the year it served most meals was 1915, with a total of 280,821 (*Boletínes de la Estadística Municipal de Bilbao*).
[14] See Larrinaga Rodríguez (2018, pp. 229-235) on the impact of the Great Depression on Biscay.

FIGURE 7
NUMBER OF PAWNED ITEMS OF CLOTHING VS. REAL INCOME.
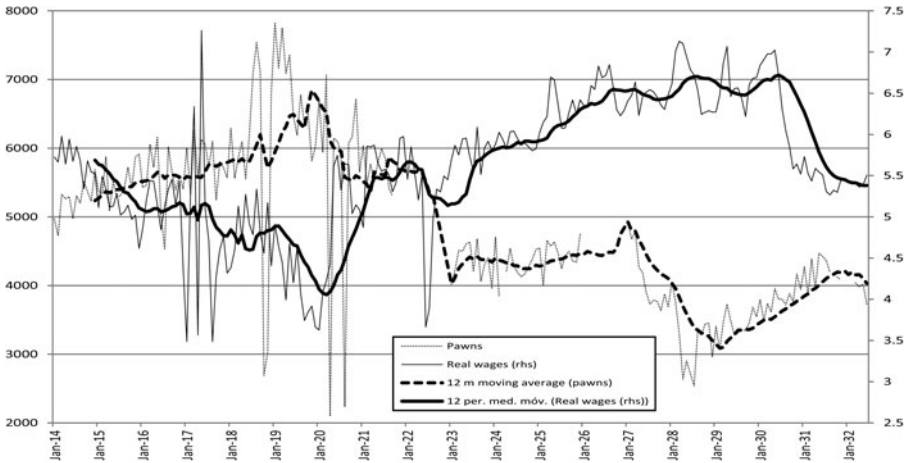
Sources: wages, costs of living and pawned items of clothing: see online appendix.

collected and reports the inverse relationship both in annualised trends and lagged peak and troughs, accentuated during strong falls and alleviated during increases in real wages. The distributed lag regressions show a significant inverse impact of real wage variation, with a delay of 6 months on tuberculosis death incidence and lung-related deaths, similar to the impact we find for overall mortality rates.

The series on nuptiality and thefts are also shown in the online appendix. Nuptiality is the only proxy we have over the entire period for underemployment and unemployment. The contractions of nuptiality during the first half of the 1920s and the beginning of the 1930s indicate labour market retrenchment. The difference is that the contraction of nuptiality persists throughout the 1930s, whereas it recovers in the second half of the 1920s. In the appendix we also show an interesting inverse relation between nuptiality and the unemployment sign-up variations reported for the 1930s (Etxaniz and Ipiña 2017, table 5). A final desperate strategy may have been opting for petty theft. Again, theft increased with delay, to decreases in real incomes. Further discussion can be found in the online appendix.

It is interesting to see that the impact of falling incomes on mortality and the other social distress indicators we have displayed may have actually been mitigated by sporadic increases in relief for the poor. Surely it is providing major relief in the 1930s. Serving up to 90,000 meals a month in 1931/32 is equivalent to feeding 3,000 people a day. Even with

FIGURE 8
MONTHLY ABANDONED CHILDREN [PER MILLE LHS] LEFT IN THE MAIN
ORPHANAGE (CASA PROVINCIAL DE EXPÓSITOS) COMPARED TO REAL WAGE.
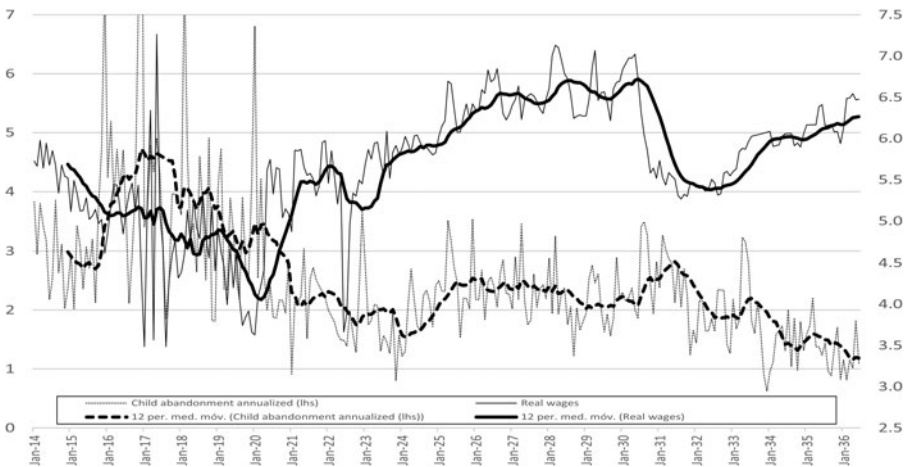
Sources: wages, costs of living and abandoned children: see online appendix.

this level of alleviation, a 15 per cent decrease in real income is associated with a 5 per mille increase in mortality during WWI and at most a 3 per mille increase at the beginning of the thirties.

4.   STATISTICAL ANALYSIS OF RESPONSE TO SHORT-TERM ECONOMIC STRESS

In an effort to address the interaction between the variables we have considered thus far more closely, we now examine whether decreases in energy purchasing power could have caused high mortality (and socio-economic strife) and if so, how soon (Lee 1981). We will examine the same relations we have graphed in the previous part of our analysis statistically. The variables to be scrutinised are mortality rates, infant mortality rates, child mortality rates (1–5 years), pawns and children abandoned to homes; rainfall and temperatures were added as controls[15]. For these statistical analyses, all variables are expressed in logarithms, which corrects for heteroscedasticity and makes additive models more suitable[16].

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[15] Statistics on nuptiality, birth rates, stillbirths, abandoned elderly, minor thefts, disruption of law and order and different causes of death have also been considered.

[16] See the online appendix for a detailed description of the sources, calculations and controls.

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The objective of our statistical analysis is to discern the impact, timing and scope of economic disruption. The preliminary vector autoregression (VAR) analysis results, which can be found in the appendix, were helpful in confirming that we are not in a Malthusian preindustrial context but that, nevertheless, there may be a strong causation running from real wages to mortality in the industrialising Bilbao estuary[17]. Additional cointegration analysis described in the online appendix consolidates the VAR results of the lagged impact of energy imbalances on socioeconomic indicators. To interpret the possible timing and impact, we will turn to a different method, the autoregressive distributed lag (ADL) regression. This method will allow us to identify the impact of both contemporaneous and previous variations in real wages on the level of mortality and indicators of economic strife. Therefore, we will be able to discern the delayed echo responses to a shock[18]. We perform this by estimating the linear relationships between the past and present fluctuations in the variables. The results we obtain may thereby be interpreted as elasticities[19].

As can be seen in the first set of regressions (Table 1), the impact of a shock on male real wages (a drop of 27 per cent between the start of WWI and the immediate post-war at an annual rate of decrease of 5.7 per cent over 5 years) would have increased the death rate in at least the same proportion; it actually increases by 32 per cent. Approximately 4,600 people would have died as a consequence of this persistent fall in real income, approximately 4.2 per cent of the population.

An important caveat is the fact that we are relying solely on a male income source. We have no comparable income data for other family members. We can only discuss the different scenarios that women's and children's incomes could have and reinterpret the results according to the change that each scenario could be introducing in family income. The optimistic scenario could be that when real male income is falling, women and children in the family could easily find work and income to compensate this fall in family purchasing power.

The results we have obtained would then indicate that the energy spent would not have been compensated by the energy gained. Otherwise we would not see a strong short-term vulnerability to changes in real male income. If, on the contrary, more work and income on behalf of women and children in the family were not readily accessible in times of strife,

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[17] We have also found birth rates Granger-causing death rates.
[18] See Lee (1981, p. 359)
[19] We have analysed the relationships between the data series with different econometric models: VAR (1), VECM and ADL model regressions in order to choose the most appropriate. We find evidence of cointegration with all variables. The preferable model is a VAR (1), similar to an ADL model, which is much easier to interpret, and is chosen here to show the relations between the variables and to discuss.

TABLE 1
DISTRIBUTED LAG REGRESSIONS DEATH RATES, REAL WAGES AND WEATHER
(TEMPERATURES AND RAINFALL) (STANDARD ERRORS IN PARENTHESIS)

	(1)	(2)	(3)
	Full sample	No outliers	(2) with t and r
DLOG(W)	–0.0499	0.2570	0.2775
	(0.1422)	(0.2622)	(0.2606)
DLOG(W(–1))	–0.1076	0.2768	0.2871
	(0.1624)	(0.2582)	(0.2593)
DLOG(W(–2))	0.0386	–0.1661	–0.0948
	(0.1663)	(0.2495)	(0.2744)
DLOG(W(–3))	–0.0706	–0.5015**	–0.3921
	(0.1655)	(0.2476)	(0.2512)
DLOG(W(–4))	–0.2946	–0.5996***	–0.4953**
	(0.1630)	(0.2451)	(0.2456)
DLOG(W(–5))	–0.3430**	–0.7414***	–0.7132***
	(0.1591)	(0.2562)	(0.2695)
DLOG(W(–6))	–0.3961***	–0.1011	0.0167
	(0.1403)	(0.2503)	(0.2462)
DLOG(DR(–1))	–0.1945***	–0.2336***	–0.2712***
	(0.0627)	(0.0687)	(0.0699)
DLOG(DR(–2))	–0.2474***	–0.1976***	–0.2106***
	(0.0631)	(0.0681)	(0.0701)
DLOG(DR(–3))	–0.1412**	–0.1505**	–0.2269***
	(0.0654)	(0.0679)	(0.0703)
DLOG(DR(–4))	–0.0710	–0.0604	–0.0997
	(0.0658)	(0.0669)	(0.0681)
DLOG(DR(–5))	–0.1641***	–0.1585***	–0.1497**
	(0.0641)	(0.0660)	(0.0685)
DLOG(DR(–6))	–0.1161*	–0.1189*	–0.0913
	(0.0634)	(0.0667)	(0.0674)
Temperatures			–0.0036***
			(0.0012)
Rainfall			0.0004**
			(0.0002)
R^2	0.1319	0.1575	0.1995
Log likelihood	82.023	103.222	106.271
Durbin-Watson stat	2.025	2.027	2.077

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

the results would be reflecting the reaction of vital statistics and indicators of distress to the generalised fall of family income. In any case, it is important to stress that the results are sensitive to change and not to levels.

The high sensitivity of death rates to changes in real male income is a sign of families living close to sustenance[20]. It would be reassuring to find that there were previous family economic stress reactions before death incidence became manifest when adjusting to falling incomes. Finding strategies such as pawning or giving children less to eat to ensure the energy balance of the breadwinners and placing children and elderly individuals in homes would reinforce our hypothesis. The set of regressions shown in Table 2 seeks to reinforce the visual examination made in the previous section on the use of these options.

Comparing infant mortality, child mortality and the overall death rate, we find a similar pattern to what Reher and Sanz-Gimeno (2000) found for short-term economic fluctuations in Spain over this period: infant mortality reacts far less to real income shocks (perhaps because lactation depends more on the mothers' reserves)[21]; child mortality (age 1–5) reacts more vehemently—in the same lags but twice as intensely—than overall mortality (perhaps indicating a reduction in small children's nutrition due to their defencelessness to reducing their food as a strategy when ends don't meet); pawning leads all other strategies—as expected—in the second month after the shock; and, last but not least, abandoning children to homes is almost contemporaneous with death, just one month after the mortality impact—a last resort to reduce morbidity. The regressions support the idea of a population living close to sustenance. The impact structure is very consistent with what we would expect families facing energy imbalances to do.

In 1930, González Ugarte (1994, p. 49) found that the highest percentage (30%) of mortality in Baracaldo—one of the main working-class suburbs of Bilbao—was attributable to respiratory illnesses. Cold weather, rain, pollution and low defences increased the probability of common colds evolving into bronchitis and pneumonias. This, of course, is only conjecture. Certainly, people did not starve to death, but they did not simply fall over and die either. Perhaps, as their health faded from the negative shocks to their energy balance, some were able to resist colds, but others were not.

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[20] When relating reductions in mortality to changes in real wages, the impact of positive changes in wages has a lag of only three months before they reduce mortality rates. The lag length increases to five months when we examine only the negative changes in real wages. People resist dying more than living, as we would expect.

[21] The metric used by Reher and Sanz-Gimeno (2000) for short-term economic fluctuations in Spain was GDP data later published in Prados de la Escosura (2003). See also Bengsston and Dribe (2005), Alter and Oris (1997), Bengtsson and Reher (1998).

TABLE 2
FAMILY SURVIVAL STRATEGIES

Y	Death rates	Infant mortality	Child mortality	Pawns	Children to homes
DLOG(W)	0.2570	0.2946	−0.0461	0.0731	0.2120
	(0.2622)	(0.4643)	(0.6047)	(0.2848)	(0.2409)
DLOG(W(−1))	0.2768	0.7687*	0.6529	0.4409	0.1615
	(0.2582)	(0.4675)	(0.6008)	(0.2907)	(0.2717)
DLOG(W(−2))	−0.1661	0.5668	0.9788*	−0.9246***	0.0145
	(0.2495)	(0.4609)	(0.5939)	(0.2816)	(0.2733)
DLOG(W(−3))	−0.5015**	0.1293	−0.7072	−0.4887*	−0.0451
	(0.2476)	(0.4589)	(0.5992)	(0.2876)	(0.2735)
DLOG(W(−4))	−0.5996***	−0.4653	−1.2557**	0.3455	−0.1907
	(0.2451)	(0.4508)	(0.5903)	(0.2828)	(0.2721)
DLOG(W(−5))	−0.7414***	−0.3654	−1.5169***	−0.3428	−0.3903
	(0.2562)	(0.4615)	(0.6027)	(0.2888)	(0.2667)
DLOG(W(−6))	−0.1011	0.2248	−0.3052	−0.1777	−0.6156***
	(0.2503)	(0.4431)	(0.5802)	(0.2719)	(0.2355)
DLOG(Y(−1))	−0.2336***	−0.5438***	−0.3514***	−0.5917***	−0.5669***
	(0.0687)	(0.0681)	(0.0677)	(0.0897)	(0.0632)
DLOG(Y(−2))	−0.1976***	−0.4772***	−0.2384***	−0.4803***	−0.4081***
	(0.0681)	(0.0772)	(0.0710)	(0.1020)	(0.0720)
DLOG(Y(−3))	−0.1505**	−0.4366***	−0.1276*	−0.7378***	−0.3197***
	(0.0679)	(0.0814)	(0.0708)	(0.1090)	(0.0752)
DLOG(Y(−4))	−0.0604	−0.3020***	−0.2278***	−0.2399**	−0.2390**
	(0.0669)	(0.0820)	(0.0700)	(0.1088)	(0.0753)
DLOG(Y(−5))	−0.1585***	−0.0835	−0.0816	−0.2646***	−0.0990
	(0.0660)	(0.0783)	(0.0704)	(0.1007)	(0.0739)
DLOG(Y(−6))	−0.1189*	−0.0749	−0.0446	−0.2539***	−0.1146*
	(0.0667)	(0.0693)	(0.0695)	(0.0888)	(0.0648)
R^2	0.158	0.275	0.181	0.484	0.285

Death, feeding children less, pawns and putting children into homes (standard errors in parenthesis).
*Note*: * denotes significance at 10%, ** at 5% and *** at 1%.

In any case, we have established a solid, strong and significant link between material income, the balance of energy this can command, mortality and other indicators of economic strife. We have established this with the nominal male income of a medium-skilled worker's family in one of the highest wage-paying industrial cities in Spain. In the struggle for sustenance, despair at the abandonment of children, the loss of lives, disenchantment with wage providers and anger at recurrent relative deprivation in a place which promised an escape from agrarian and traditional sector crises seems a natural sequence to expect.

The new data establish the existence of a clear mortality response to short-term economic stress in our urban industrialising setting. The data are suggestive of an urban population whose nutritional status was vulnerable, similar to what Molitoris and Dribe (2016) found in the case of Stockholm for the same time period. Traditional measures of material well-being for single male workers show improvement, but the complementary standard-of-living indicators bring to light family vulnerability in the face of recurring income shocks during the interwar period. Higher mortality in response to short-term economic stress must be regarded as an indication of a population living close to nutritional sustenance levels. Our analysis has exposed exactly such a response. Other indicators of economic strife examined here provide additional support for this hypothesis. Families reacted first by pawning clothes; higher child mortality seems to reflect the weak position of small children in the food chain as an easy option to adjust to less food in the family; and children are finally abandoned to a higher extent to homes as a last resort. We also have indications that some may have even resorted more willingly to theft as a last option (Figure 9).

Some things need to be said about family strategies. Among the first options to be considered to compensate price increases was spending less on non-food items. A majority of working-class families living in Bilbao at the time of our analysis spent over 70 per cent of their family budget on basic necessities. The margin for reducing non-food items was limited, as the massive rioting by women in reaction to attempts to increase housing rentals at the beginning of 20th century may reflect. Purchasing cheaper food items and food substitution may have been next in order of choice. Cheaper foods often require more preparation; they may have a lower metabolic efficiency and higher volume, making them less attractive. An increased demand for restricted amounts of cheap foods tends to increase their prices at a higher pace than that of large volumes of standard staples (Aguirre 1994, pp. 302-304).

Bilbao's main economic activities all have heavy physical workloads in common. Even to the present day, a «strong-body—high-performance» diet has persevered in Bilbao. This social identity of the «strong-body

FIGURE 9
FAMILY STRATEGY WITH DIMINISHING PURCHASING POWER.
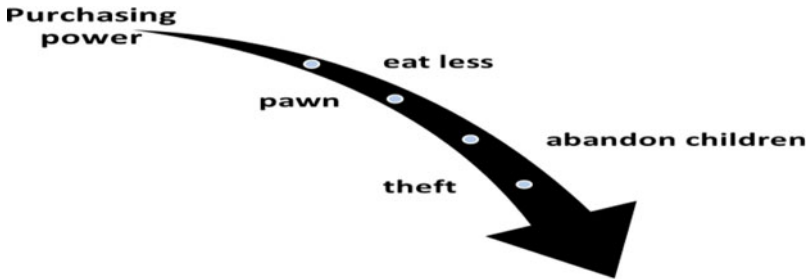
Sources: own elaboration.

worker family» has persisted over time into our days, mainly in the form of food representation. Legume pottages high in carbohydrates and fats are the staple dish in most of Atlantic Spain stretching from the Basque country through Cantabria and Asturias to Galicia. Pottages can be thinned with water and stretched with bread to feed more mouths; they symbolise hearty, hot, thick and strong nutrition. Our assumptions are that families had very limited margin for reaction to adjusting their staple diet with cheaper foods.[22] This is a counterintuitive survival strategy that becomes part of an identity. Families neither reduced the proportion of outlay devoted to food nor the staples-food ratio as long as they remained below a critical level of outlay per family member (Payne and Lipton 1994, p. 97).

As soon as price increases were perceived as irreversible—neither seasonal nor fortuitous—different strategies had to be adopted. Other family members tried to find more formal or informal work. Price increases affected all working-class families in equal terms and having a mass of family members seeking employment opportunities reduced the probability of successfully reducing economic strain. Consequently, the most widely available alternative was for unemployed family members to eat less. Some compensation may have been obtained by working extra hours, but this would be reflected in the nominal income we are using. Family members were much more likely to work more slowly to reduce work energy expenditure and to stretch reduced nutritional energy as a last resort to resistance. Chewing slowly, eating smaller quantities more often and managing physical activity parsimoniously may have also contributed to optimising metabolic efficiency, although this was clearly a strategy of resignation and acceptance of the situation.

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[22] Similarly, Aguirre (1994) found a low-rent elasticity violating both Engel's and Bennet's laws for ultra-poor families in Argentina in the 1990s.

The strain on family nutritional status reduced the available strategies for resistance. A brief source of relief, reserved as a strategy of last resort, were collateral loans, pledging family assets in exchange for money to be paid back. This short-term credit for the working class generally took the form of pawning family jewellery or heavy clothing. Community neighbourhood sharing and solidarity was another option, but its success as a strategy rested on the heterogeneity of income groups and neighbourhood networks. When all were homogeneous and were affected equally, there was not much room for manoeuvre for intra-neighbourhood transfers. Higher coordination in time was also an option, that is, consumption smoothing by way of storage. However, higher preservation of food requires a learning process and knowledge of preservation. We can assume that this was a strategy available to few. Sending away family members seems to be a much more feasible option, maybe not much so in the context of the interwar depression and crises in the places of origin. Abandoning children and elderly individuals to poor institutions due to dire straits was a contrasted phenomenon. Once all other available options had been exhausted, resigning oneself to eating less than necessary and depleting reserves was a traditional defence mechanism to face nutritional shortages.

5. CONCLUSIONS

According to our new calculations, standards of living measured in terms of the nutritional energy families could buy compared to their nominal male-income energy purchasing power worsened between January 1914 and December 1919. They improved from January 1920 to April 1930, after which the material standards of living worsened again until August 1932. They recovered to the levels attained in the mid-1920s by May 1935 but started a downward trend from there on. Welfare ratios were more or less at the same level in late 1935 as at the beginning of 1914. No cumulative betterment in the energy-nutrition family standard of living was attained over the period as a whole. Living conditions deteriorated during the war and post-war economies, they went on to improve during the Primo de Rivera dictatorship, and during the Second Spanish Republic standards of living for these families were maintained, worsened and then improved slightly[23]. In light of the differences with the findings of substantial improvement of living standards by Olábarri (1978), Perez Castroviejo (2006) and Escudero and Pérez Castroviejo (2010) for male workers, we have reaffirmed these findings with conventional statistical analysis and contrast them with other evidence of economic strife to show the results we put forward for families are robust and coherent.

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[23] For similar results see Borderías *et al*. 2022.

The high sensitivity of death rates—especially the child mortality rate—to changes in real family income is a sign of the population living close to sustenance. The significance and timing of the evidence on how family strategies counteract economic shocks—reducing consumption, pawning, child abandonment, postponement of marriage and recurring to theft—endorse our hypothesis of family vulnerability exposed to nutritional energy imbalances. The close calibration of the energy requirements of a blast furnace worker's family and the male wage proxy as their nominal income purchasing power allow us to construct a thermometer for worker families' energy balances. Assuming that in this high-wage high-energy industrial setting the fruits of labour are strongly related to physical effort and the correlation of effort and pay—both for women and men—our thermometer should be indicative of economic stress for the majority of high-energy worker families. The visual examination with economic strife indicators and statistical contrasts confirms this postulation. The missing incomes from women and children accentuate the results we obtain. If they were compensating falling real male incomes in times of strife, the energy they provided was not enough to compensate the energy exerted in doing so. If they had few opportunities to compensate, the results we show reflect family reality closely.

These results raise a number of interesting questions. The most obvious being why these results are in contrast to other studies. The fact is that the vast majority of the studies performed for this period rely on annual data put together piecewise, driven by the ambition of producing long series and uniting all surviving data references. They also omit living standards for families and concentrate on single male workers. This is done with the best of intentions but may be important in explaining the differences. More homogeneous and representative data taken from single sources surely improve the quality of the assessment that we present. Calibrating family consumption in terms of energy and taking into account the food transition may also contribute to differences. Nevertheless, our results also hold up when we use a fixed basket throughout the analysis. Using a moving basket added to, but is not essential to, the differences observed.

Another question is latent in the concentration and vehemence of protests by miners, metallurgic workers and dock workers. Traditionally, this has been associated with the brute physical strength exerted in their jobs, making them more prone to violent physical protest and the nature of their coordinated batch teamwork promoting the mechanisms of collective action. Our work introduces an additional element to consider. These workers and their families were much more vulnerable to energy imbalances produced by the falls in their food-cost-adjusted incomes. Economic price shocks with slow adjustment of nominal wages moved them and their families quickly to and below sustenance levels of nutrition. They were much more vulnerable to economic stress than low-energy workers.

If the 20 per cent nominal wage cut proposed by the major Bilbao employers on 3 May 1922, bringing wages back down to the pre-war levels, had been followed by all employers in Bilbao at the time, this would have killed over 2,700 people over the next 5 years[24]. This is a different way of understanding economic strife in a high-wage high-energy economy. Slightly increased morbidity and silent deaths at a rate of 40-45 deaths per month over a prolonged period of 5 years may just have been perceived by the families of the affected individuals as a fortuitous stroke of bad luck. Not attaining the necessary levels of nutritional sustenance and the sensation of intertemporal deprivation, which were at the root of increased morbidity and mortality, were being felt by all. These circumstances were not forgotten in the wake of the promises of betterment with the coming of the Spanish Republic and the prelude to the Spanish Civil War.

SUPPLEMENTARY MATERIAL

The supplementary material for this article can be found at https://doi.org/10.1017/S0212610922000131.

ACKNOWLEDGEMENTS

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