Scarring through the German hyperinflation

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Abstract: I study the link between the 1923 German hyperinflation and health by linking monthly data on the cost-of-living index with monthly infant and cause-specific adult mortality rates in 280 cities. By exploring panel data with a range of fixed effects, I find that hyperinflation boosted mortality rates. The largest increase in mortality came from rises in amenable mortality, which are cause-specific deaths plausible linked to deteriorating social conditions over the short-term, such as deaths from influenza, meningitis, scarlet fever, tuberculosis, and whooping cough. I also rely on children's heights and weights to show that worsening health was related to impaired nutrition. The results are robust to a range of specifications, placebo tests, and Conley standard errors.

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Abstract

I study the link between the 1923 German hyperinflation and health by linking monthly data on the cost-of-living index with monthly infant and cause-specific adult mortality rates in 280 cities. By exploring panel data with a range of fixed effects, I find that hyperinflation boosted mortality rates. The largest increases in mortality came from rises in amenable mortality, which are cause-specific deaths plausibly linked to deteriorating social conditions over the short-term, such as deaths from influenza, meningitis, scarlet fever, tuberculosis, and whooping cough. I also rely on children's heights and weights to show that worsening health was related to impaired nutrition. The results are robust to a range of specifications, placebo tests, and Conley standard errors.

1 Introduction

Throughout the short-lived period of hyperinflation, there was a surge in prices that soared to one trillionfold. As of the summer of 1922, German prices exhibited an escalation with rates surpassing 50 percent per month. The ensuing summer saw an intensification, exceeding 100 percent monthly. In the autumn of 1923, the inflation rate reached an unprecedented 1,000 percent per month, prompting prices to double or triple within a week. A loaf of bread, which cost 250 marks in January 1923, rose to 200,000 million marks in November 1923. While the German hyperinflation meant the collapse of the economy and daily life, it became clear that it had ramifications that extended to many aspects of the financial order. Many complex health changes were emerging at the same time. The negative monetary shock was compounded by poorer nutrition and impairing heating and housing conditions, turning the economic shock into a health crisis. As Robert Clive, consulgeneral in Munich denounced in October 1923, "Few families can afford meat more than once a week, eggs are unprocurable, milk terribly scarce and bread already 16 times the price of a few days ago... No one expects political disturbances but hunger riots are another matter... and the cold, no one can afford central heating.

In this paper, I provide new evidence on how the 1923 hyperinflation, the defining episode of the 1920s, affected the German health condition. I gathered monthly mortality data for 280 localities for between January 1922 and December 1923, categorized by cause of death, and combined to corresponding data on the cost of living, which also varies, for the same cities, on a monthly basis. Although hyperinflation was a national phenomenon, it had a differential impact across regions. For instance, prices were higher in West Prussia, and along the French border, and especially in states like the Rheinprovinz, Westfalen, and Oldenburg, and tended to decrease, so to speak, from west to east (Galofré-Vilà 2023, Bresciani-Turroni 1931, Braggion et al. 2023).

The empirical analysis utilizes these high-frequency data through panel regressions, controlling for fixed effects of city and month-year. I find that hyperinflation did increase excess mortality in Germany. A one-standard-deviation increase in the cost-of-living data is associated with an increase in the crude death rate (in standard deviation terms) of between one quarter or one third of one standard deviation (depending on how mortality is measured). I also find evidence that excess mortality took place along *amenable* mortality—deaths linked to short-term economic stress and that are avoidable with timely and effective healthcare—and among infants

To identify causal chains, I rely on panel data with city and month-year fixed effects, limiting the possibility that unobservables are driving the results. Among other robustness, I also employ a lag-distributed model by incorporating five lags and leads controlling for the time duration of the shock and showing that future prices do not explain current deaths.

To remove the worry of spatial autocorrelation in the residuals, I employ a Conley correction of standard errors for spatial correlation. To further assess the significance of the findings, placebo tests reveal that some causes of death less likely to be affected by the hyperinflation shock, such as vector-borne diseases or deaths from cancers (which would have a long lag between carcinogenesis and death), were uncorrelated with the financial collapse. By contrast, highly communicable and infectious diseases that can be linked to short-run economic stress like tuberculosis and other acute respiratory problems like influenza, which can be avoided with effective care and nutrition or better housing conditions, are rapidly predicted by the cost-of-living data.

While the above strategies lend credibility to the findings, problems of endogeneity cannot be ruled out. However, with these identifications any endogeneity problem would stem only from time and city varying omitted variables, which are difficult to observe as similar high-frequency data on background characteristics of the cities are simply unavailable and therefore untestable (see more details in Section 5). Nonetheless, the causes behind the German hyperinflation are well studied by Gerald D. Feldman and others (see next section) linking it to poor monetary policy and World War 1 (WW1) instead of a health shock.

There is also a strong inter-war narrative that support these findings. For instance, Evans (2004: 106) identifies that "the collapse of the mark made it difficult if not impossible to import supplies from abroad. The threat of starvation, particularly in the area occupied by the French, where passive resistance was crippling the transport networks, was very real. Malnutrition caused an immediate rise in deaths from tuberculosis." Ferguson (2010: 15) also opined that "1923 brought catastrophe to the German ... bourgeoisie, as well as hunger, disease, destitution and sometimes death to an even wider public." See additional opinions in Section 5.

As a third piece of evidence, I look at the change over time in children's heights and weights, as a measure of net nutrition, in more than 600,000 anthropometric records collected and analyzed by Cox (2016, 2019). The average height and weight of a population are themselves a form of composite measure since they reflect the net impact of the dietary resources consumed by human beings and the demands made on those resources by energy use and, in particular, disease (Floud et al. 2011, Galofré-Vilà 2018, Harris 2021). Here, I find that during WW1, children's nutrition deteriorated, but after 1918, a monotonic recovery took place, only interrupted in 1924 as a result of the hyperinflation months in the fall of 1923 where millions of Germans were living in abject poverty. As Franz Geyer, the future mayor of the Ruhr valley city of Bochum, wrote: "Never in my life have I seen such swarms of starving people wandering about" (seen in Jung 2009).

While there have been several comprehensive reviews on the health consequences of bank failures, financial imbalances, bubbles, and related economic downturns (Catalano et al. 2011, Ruhm 2000, Stuckler and Basu 2013),[1] with large evidence that shocks arising from recessions trigger health problems, to my knowledge, this is the first time that a historical empirical link between hyperinflation and health problems has been demonstrated. Nonetheless, it connects with recent works published in medical journals. For instance, the work from Page et al. (2019) discuss how hyperinflation in Venezuela triggered food insecurity, reporting that tuberculosis rates in 2015 were the highest in the country in 40 years (see also Doocy et al. 2019). The work from Kapp (2004) also denounces that because of Zimbabwe's dizzying inflation rates, tuberculosis rates surged and efforts to fight malaria were crippled by a lack of resources. In the last two years, due to Russia's invasion of Ukraine (the so-called breadbasket of Europe), Western countries are also witnessing severe disruption in the supply and rising prices of food and energy threatening the financial situation of vulnerable families. Furthermore, while there has been extensive analysis of the causes and consequences of German hyperinflation (see, for instance, Feldman's *opus magnum* (1997) and Holtfrerich's *masterly study* (1986)), there is surprisingly almost nothing on demography and public health.[2]

After a brief review of the origins and developments of the German hyperinflation (Sections 2 and 3), I present the data (Section 4). This is followed by the empirical results and robustness checks either using mortality rates with fixed effects models (Section 5) or exploring children's heights and weights over time (Section 6). Section 7 concludes

2   The German Hyperinflation

From the beginning of WW1 to the end of hyperinflation in 1924, German inflation rose exponentially. Like most European countries, Germany had financed the war by increasing domestic debt and printing money, so when the war was over, inflation was already an issue. The annual inflation rate before and after WW1 had grown by 84.6% in Austria, 71.1% in Hungary, 42.2% in Italy, 35.9% in France, 23.1% in Britain and 21.2% in Germany (Lopez and Mitchener 2021). Nonetheless, inflation problems further increased following the closure

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[1]Recessions tend to be damaging to mental health (Case and Deaton 2020) and major outbreaks of communicable diseases typically occur during economic downturns (see Stuckler and Basu 2013).

[2]Winter and Cole (1993) looked at how the post-WW1 period in Berlin was reflected in infant mortality.

of the Great War. The Versailles Conference (which ended in the summer of 1919) greatly compromised Germany's future. The Allied Commission forced Germany to pay the bill for the war, treating Germany as a conquered enemy and surpassing its capacity to pay. This placed impossible financial demands on Germany and was dubbed as "cruel" by some (Keynes 1920). The following months were overshadowed by more inflation, the threat of depression, political turmoil, and a tax boycott that worsened uncertainties over payments.

Concerns were temporarily halted with a new constitution and Erzberger's fiscal reforms, which tried to strengthen the budget position by centralizing taxation and attempting to increase tax revenue by instituting a hefty income tax and a one-time capital levy (Hubbard 1990). However, under the punitive reparations of Versailles, relying on tax hikes was not an option as, for the German taxpayers, money would have been used to repay Germany's debts. Because of uncertainties over payments, in May 1921, the London Ultimatum demanded a front-end payment of a thousand million Gold Marks by August in foreign exchange, and an additional 500 million Gold Marks by November (Eichengreen 1996). These demands amounted to about half of the total German tax revenue. If the conditions of the Ultimatum were not met, the Allies threatened Germany with the occupation of the Ruhr (Germany's western mining district). The immediate consequence of this threat was the fall of Chancellor Fehrenbach. Subsequently, since the Reichstag refused to hike taxes, by October 1921, the Allies annexed Upper Silesia to Poland. As a protest against these stiff terms, Germany suspended all payments in June 1922 and, by early 1923, it failed to make deliveries of coal, as payments in kind, to France, with France and Belgium occupying the Ruhr. Occupation was met by the Germans with passive resistance and inflation turned into hyperinflation.

Monetary policy was out of control, and from September to November, prices changed more than once every day. This was the time when Germans carted worthless Marks in suitcases and wheelbarrows filled to the brim with cash, and millions of Germans lost their jobs, savings, and hopes. Unable to afford the most basic necessities, crowds soon began to riot. At that time, commentators noted that "plundering and riots were a daily occurrence" (Schacht 1927). These events included the Beer Hall Putsch, a failed *coup d'état* led by the Nazis in November 1923, in which Hitler was arrested and charged with treason.

Along with problems in the balance of payments (i.e., disturbances in the foreign exchange market, rising import prices, and money creation), hyperinflation also occurred because of budget deficits financed by printing money. Expectations over the Mark also mattered, and the events that took place after the middle of 1922, including Germany's unilateral end to payments, the occupation of the Ruhr, and the assassinations of Erzberger and Rathenau (the minister of finance and the minister of foreign affairs, respectively), further undermined confidence in the stability of the German Mark.

Stabilization started by the end of November 1923. Measures to stop hyperinflation had already begun in the summer of 1923 with the new government under Stresemann but were implemented by Marx after November 1923. These included a 500 million Gold Mark loan, with bonds widely accepted as hard currency. In November, a new temporary currency appeared, the Rentenmark, and, in August of the next year, the Reichsmark replaced both the Mark and the Rentenmark. Its exchange rate was at 10,000 trillion Marks and, since the Reichsmark was tied to the price of gold, it achieved general acceptance. Beyond monetary efforts, it was not until Stresemann's government agreed to call off the passive resistance in October 1923, and France signaled some willingness to reconsider the reparations bill, that

prices began to stabilize. As Eichengreen (1996: 127) explained, "until the dispute over reparations subsided ... none of the prerequisites for monetary stability was present until 1924, and inflationary chaos was the result."

A critical element for stabilization arrived with the Dawes Plan in August 1924, which rescheduled Germany's obligations (although they were not significantly reduced), with the immediate debt service payments being scaled back to a fraction of what they had been in 1921/22, since payments were limited to some 1% of GNP. Central to the success of the Dawes Plan, was a foreign loan amounting to 800 million Gold Marks of foreign currency (with the U.S. floating half of the loan). What followed in the mid-1920s was an economic boost, frequently referred to as the 'Golden Twenties,' with a compound annual growth rate of 5.1% between 1924 and 1928.

3   Distributional battles

During the hyperinflation months, financial chaos disrupted productive activity in all sectors, shrinking the size of the pie to be distributed. Arguably, the biggest economic losers from the inflation were people from outside Germany who held obligations payable in Marks. Then, German pensioners and wealthy Germans, such as bondholders and rentiers, also became largely impoverished; as Voth (1994) commented "the inflation had virtually wiped out the entire German 'rentier' class; a whole group of citizens had to work for a living rather than leading a pleasant life on the basis of income from capital."

Despite it being repeatedly stated that the middle class was severely hit by the hyperinflation, the effects on this group were very heterogeneous and, as Hubbard (1990: 562) maintained, "the persistent notion that the inflation 'destroyed the middle classes' must be substantially revised, if not completely discarded." Similarly, Evans (2004: 109) also opined that "it used to be thought that it destroyed the economic prosperity of the middle class. But the middle class was a very diverse group in economic and financial terms." For those on a fixed income, the results were ruinous, but wages were generally protected by the unions and tended to preserve their value once nominal wages reflected the pace at which prices rose. Wages were set by the *Zentralarbeitsgemeinschaft* and both trade unions and employers were represented.

Unemployment rates remained low, reaching a peak in January 1923 (26.5%) but declining thereafter (8.6% in May of the same year) (Evans and Geary 1987: 24). For most farmers, hyperinflation also meant that agricultural prices sharply increased, and that they could liquidate their indebtedness and redeem their mortgage debts at a fraction of their pre-war real value. As Gómez León and de Jong (2019) have argued, during the hyperinflation all Germans lost and became impoverished, but those at the top of the income distribution lost more, making the income distribution more egalitarian (see also Gómez León and Gabbuti 2022). In a similar vein, Bartels (2019: 13) has also pointed out that the "hyperinflation likely contributed to reducing inequality."

4 Data

This paper combines several data sources for interwar Germany at the city level, some of them hand-collected and digitized for the first time.

As a way to monitor local inflation in the German economy, starting in December 1919, the Statistics of the Reich Office in coordination with the German Department of Labor (*Reichsarbeitsministerium*) issued the Inflation Statistics of the Reich (*Vierteljahrshefte zur Statistik des Deutschen Reichs*) capturing local inflation by a cost-of-living index (*Teuerungsraten*). This cost -of-living index was based on surveys carried out in 560 cities of varying population size (for those above 10,000 inhabitants) and after June 1923, in 280 cities (see more details below), balancing the prices of a basket of goods underlying the local prices and cost-of-living statistics for a family of five (two adults and three children aged eighteen months, seven, and twelve years respectively) on food, accommodation, heating, and lighting and, from April 1922, also clothing. It accounted for 87% of the expenditures detailed by the household surveys of 1907 and thus was aimed to capture the components of a conventional standard of living rather than the necessities of subsistence.

In each town, the price information was verified as accurate by employers of the Central Statistical Office of the different German states/provinces. The State Statistical Office then calculated the "dearness statistic" and forwarded it to the Reich Statistical Office. Price statistics for each town were then compared by a so-called "express service" set up to collect price information in 71 cities in just one day to yield a cross-nationwide cost-of-living index. To build the basket it was not just necessary to know the local prices, but to ascertain the quantities currently available in each place to a family of five, based on the calorific value and protein content.[3]

This new granular data on the cost-of-living index make possible intertemporal comparisons within one and the same city and allow for seasonal variations in consumption. At first, prices were indexed once a month, by the beginning of 1922, they were indexed twice, and after March 1923 nearly every week. Among other issues, it considers changes in the families' consumption patterns due to the crisis. Indeed, the prices studied here are the same data as were used by the German government, trade unions and workers to settle collective wage agreements in the face of rising prices. Bresciani-Turroni (1931: 29) emphasized that "this index was considered by distinguished German statisticians as a sufficiently satisfactory measure of the variations in the cost of living" and Holtfrerich (1986: 29) that "Repeated checks have confirmed that ... the estimates of price change yielded by this method are representative for all German towns with populations in excess of ten thousand" (see also Hachtmann 1988). Through different statistical tests, Galofré-Vilà (2023) also showed that the validity of the cost-of-living data dispels potential worries that in the price data there is not enough information in the variation (all noise) for its effects to be reflected in the voting preferences later on (i.e., cross-sectional variation in inflation is meaningful and has real effects in the later elections).

Nonetheless, the index has been somewhat debated because three important elements of the family's basket (namely education, recreation, and transport) were unrepresented. German authorities defended this choice as these items were heavily subsidized by the different

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[3]In case the quantities fell short, it was assumed that it was purchased on the black market.

states or localities. Other negative views of the index might relate to missing some essential household items such as soaps and items of personal cleanliness. Here the German authorities defended that the net effect of these omissions might conceivably be small. Despite these and other views, a downside of this source is that while the number of cities from January 1920 to June 1923 is balanced to over 560 cities, after June 1923 the number of cities drops to around 280. To understand the causes behind this fall, Galofré-Vilà (2023) showed that after 1923 were mostly smaller cities that failed to report the cost-of-living data. However, there were no baseline statistical differences in economic, labor, or social characteristics between the cities before and after 1923. Throughout I keep a balanced sample of 280 cities. The data in this study cover cities inhabited by a total of 22.1 million, a sizable fraction of the German population, which was 60.1 million according to the 1919 population census. Descriptive statistics of key variables are available in Table A1.

Mortality data for the aforementioned cities were obtained from a new dataset collected from the demographic statistics of the German Health Bulletins (*Reichs-Gesundheitsblatt*), which was a regular publication of the Reich Health Office (*Veröffentlichungen des Reichs-gesundheitsamts*). From these monthly reports detailing the health situation in Germany, I extracted new data covering the months between January 1922 and December 1923 on the main vital statistics (births and deaths). Monthly city-level births were available for both local and foreign populations, as well as legitimate and illegitimate births. Deaths were also available for national and foreign infants (below age one), stillbirths, and national and foreign total deaths. In addition to this, cause-specific deaths were available for different causes of death plus a residual category leaving a balanced sample for 10 causes. If in some months there were omissions or inclusions, they simply reflect the contemporary health situation in Germany, with a special emphasis on the spread of infectious diseases. Using the above indicators, it was possible to create infant mortality rates (the number of infant deaths—below age 1—per thousand live births) and crude death rates (the number of deaths above age 1 per thousand population) since the total population of each city was also reported. Also cause specific death rates (deaths from influenza or tuberculosis per thousand population). However, death rates for the subgroups of national and foreign population were not available due to the absence of time-varying population data.

5 Empirical results

5.1 Preliminary evidence

I begin presenting a bird's-eye view of how the hyperinflation experience led to greater suffering and mortality in the different German states. Figure A1 reveals a positive association between the cost-of-living index when hyperinflation was at its height (between October and December 1923) and mortality rates (also between October and December 1923), as captured by crude death rates and infant mortality rates at the state-level. All variables are reported in logarithms, and the graphs display elasticities. While the correlations are strong (low p-values) the coefficients of determination for both linking adult and infant mortality and the cost-of-living index are high, with cross-state evidence during the "eye of the hurricane" (in the fall of 1923) indicating that between one third and one half of the mortality can be

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due the rise in prices.

Nonetheless, while these scatter plots highlight close correlations, there is a threat on endogeneity and reverse causality, and for instance, towns where prices climbed sharply may have already been more economically vulnerable before the crisis or had weaker institutions. Using the same cost-of-living data, Galofré-Vilà (2023) has shown evidence that in saturated regressions, neither political outcomes nor the background characteristics of the cities, such as the local labor markets or religion, were systematically correlated with the cost-of-living index. However, since the cost-of-living index was correlated with geography, proximity to the Ruhr and closeness to the French border mattered. This means that the cross-city variation in local inflation is not fully random but likely correlated with other local geographical factors.

To address problems of endogeneity and unobservables in the cost-of-living data and move beyond cross-sectional results (by definition, hyperinflation is already a change in prices), in what follows, I rely on panel analysis using a battery of fixed effects and population-weighted regressions to limit the possibility that unobservables explain the findings of the paper. Panel data with fixed effects results survive to a battery of robustness checks, including a lag-distributed model by incorporating five lags and leads and a non-parametric estimation approach dividing the cost-of-living data into intervals or bins. Additionally, Conley standard errors are used to allow for spatial dependence of errors across observations. Given the high -frequency data at hand, it is hard to think of an instrument that varies across months, and if this is not the case, it would be related to a linear combination of the fixed effects in the model, leading to a lack of identification.

5.2   Panel data with fixed effects

To go beyond the graphical evidence, I have linked monthly infant and non-infant cause-specific mortality data from January 1922 to December 1923 in 280 cities to the cost-of living index data using panel data with fixed effects in the following way:

$$log\ D_{cym} = \alpha + \beta\ log\ CLI_{cym} + \gamma_c + \delta_t + e_{cym}, \tag{1}$$

where c denotes cities, y years, m months and D deaths. Deaths refer to either infant mortality rates, crude death rates, and amenable mortality rates expressed in logarithms. I report separate results for each outcome. Amenable mortality refers to cause-specific deaths plausibly linked to deteriorating social conditions over the short-term per thousand population and includes deaths from influenza, meningitis, scarlet fever, tuberculosis, and whooping cough, all endemic at the time. Robustness checks on how these variables were created (i.e., the causes included in this group) are available later on.

In the right-hand side, CLI is the cost-of-living index, also available for the city c, year y and month m and also in logs. As denoted by γ_c, I also add city-level fixed effects and δ_t are year-month fixed effects. Since I use time and local fixed effects, and the treatment/endogenous variable is time-varying, results can be interpreted as deviations of mortality from its within-sample mean. Geographical fixed effects control for non-time-varying unobservable characteristics, absorbing much of the time-invariant characteristics of the cities. Month-year period fixed effects control for non-individual-varying unobservable

characteristics, the overall time trend, and factors such as national inflation and the state of the labor market. Robust standard errors are clustered at the state level, though clustering at lower levels (i.e., city) displays similar levels of statistical significance (unreported here). To control for crowding and the spread of communicable diseases and eliminate the undue influence of small cities and proxy the city of the local economy (if correlated with population), I also weight the regressions by the level of population.

Table 1 displays the most significant outcomes of the paper, indicating a positive impact of rising prices on mortality. It reveals that towns experiencing relatively higher hyperinflation also experienced higher mortality, measured either by infants or adults.[4] Specifically, since I compute elasticities, a one percent increase in the cost-of-living index is associated with a 2.4 percent increase of the infant mortality rate (0.02; 95% confidence interval (CI): from 0.01 to 0.04) and 14.3 percent of the crude death rate (0.14; 95% CI: from 0.03 to 0.26). In terms of standard deviations, this is equivalent to say that a one-standard-deviation increase in the cost-of-living data is associated with an increase in the crude death rate (in standard deviation terms) of nearly one quarter of one standard deviation (2.24; 95% CI: from 0.40 to 4.08).

Interestingly, when comparing columns 2 and 3 (showing all deaths or deaths from amenable mortality), a significant differential gradient between overall adult deaths and deaths from amenable causes emerges (with the coefficient size for the latter being two and a half times higher), revealing the extent to which communicable and infectious diseases were highly responsive to short-term social stress during the collapse of the economy due to hyperinflation. Here, a one-standard-deviation increase in the cost-of-living data is associated with an increase in the crude death rate of amenable mortality (in standard deviation terms) of nearly one-third of one standard deviation (3.10; 95% CI: from 1.42 to 4.77).

In column 1 I also show that the hyperinflation predicts infant deaths, despite the size of the coefficient is markedly lower than in adult mortality. As for the rise in infant deaths fueled by hyperinflation, as noted by Dr. Koch Schwalbe, staff of the Berlin City Orphanage, "one need look no further than the social dislocation caused by inflation to understand the crisis of infant mortality." As for the main causes on the excess of infant deaths, Winter and Cole (1993: 250) conclude that "if the Gross Berlin figures for 1923 are any indication, it was no longer digestive diseases, but rather respiratory problems, which took the greater toll of infant life in Berlin." As for the lower size of the coefficients, because births in the poorest families fall disproportionately during a recession, they probably underestimate the "true" infant mortality rate. According to Rajeev and Lleras-Muney (2004) they represent a lower and conservative bound estimate. Ferguson (1995: 419) corroborate this view for the city of Hamburg, noting that "the birth rate fell sharply; while poor nutrition drove up the rates of still birth, illegitimate infant mortality and lung disease."

To make sure that the results are not simply displaying under-reporting births during these turbulent months, fluctuations in the denominator because the occurrence of the shock could increase stillbirths and decrease live births (raising the infant mortality rate),[5] and more home deliveries as the hospitals collapsed, I use total birth as the outcome variable in

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[4]Moreover, I remove one city at a time, showing that the findings remain stable across samples and are not driven by outliers (unreported here).

[5]For instance, respiratory illness hit babies pretty hard as well.

the high-frequency panel regression framework to show that this is not the case (-0.02; 95% CI: from -0.10 to 0.05). The same is true if I use the crude birth rate as an outcome (0.02; 95% CI: from -0.02 to 0.06). In addition to this, if in column 1 I add a control for the crude birth rate, the size of the coefficients declines by 8.3% but the cost-of-living data keeps its statistical power as a predictor (0.022; 95% CI: from 0.004 to 0.040).

Table 1. Panel data for the impact of hyperinflation on mortality (in logarithms)

|	Infant mortality	Adult mortality	Amenable mortality
	(1)	(2)	(3)
Cost-of-living (in logs)	0.024**	0.143**	0.363***
	(0.010)	(0.056)	(0.096)
Observations	9,622	9,622	9,622
Year-month fixed effects	Yes	Yes	Yes
City fixed effects	Yes	Yes	Yes
Population weighted	Yes	Yes	Yes

Outcome variable is infant mortality (column 1), adult mortality (column 2) and amenable mortality (column 3) as stated in the table and in logarithms. The variable amenable mortality (column 3) combines the total number of deaths from influenza, meningitis, scarlet fever, tuberculosis, and whooping cough per thousand population. This is a panel with monthly data from January 1922 to December 1923 for a balanced panel for 280 cities. The cost-of-living index is the *Teuerungsraten* index, also expressed in logarithms. All regressions include city and date fixed effects (year-month fixed effects) and are weighted by the size of the city-population with robust standard errors (in parentheses) clustered at the state-level. See equation (1) for details on methods, *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Given the very granular data at hand, it is also possible to delve further into the mechanisms and explore cause-specific death rates. Results in Figure 1 show two unambiguous findings. First, as already seen, hyperinflation mostly raises causes of death from infectious and contagious diseases such as deaths from influenza, tuberculosis, whooping cough, meningitis, and scarlet fever, which before were grouped into amenable mortality. All these causes in isolation could be linked to short-term economic stress, rapidly spread, and with many deaths avoidable with better nutrition and housing conditions. For instance, diphtheria, whooping cough, or respiratory problems are airborne diseases that spread easily from one person to the next through the coughs and sneezes of infected people.

By contrast, Figure 1 also presents a placebo test exercise in which certain causes of death less likely to be affected by the local economy and the rise in prices are examined, and it is found that they do not predict mortality or with less precision (no statistical significant p-values). For instance, dysentery is mainly caused by contamination of food and water with feces due to poor sanitation and can be prevented with hand washing and food safety measures. The rise in prices does neither predict typhus, which is mostly caused by the spread of fleas, body lice, or chiggers. Violent deaths, despite including a rough classification of deaths resulting from intentional use of physical force such as homicides that can increase as resources become scarce, also include accidents and a range of poorly identified causes with a poor identification. Finally, other causes include non-amenable mortality mostly from

cancer (which would have a long lag between carcinogenesis and death) and heart related diseases like heart diseases, high blood pressure or congenital heart conditions. The bottom line here is that these causes of death, are simply less well identified and predicted by the hyperinflation, despite they can be indirectly affect by deteriorating social conditions but ultimately showing weak correlations and large p-values.

Figure 1. Panel data for the impact of hyperinflation on cause-specific mortality.
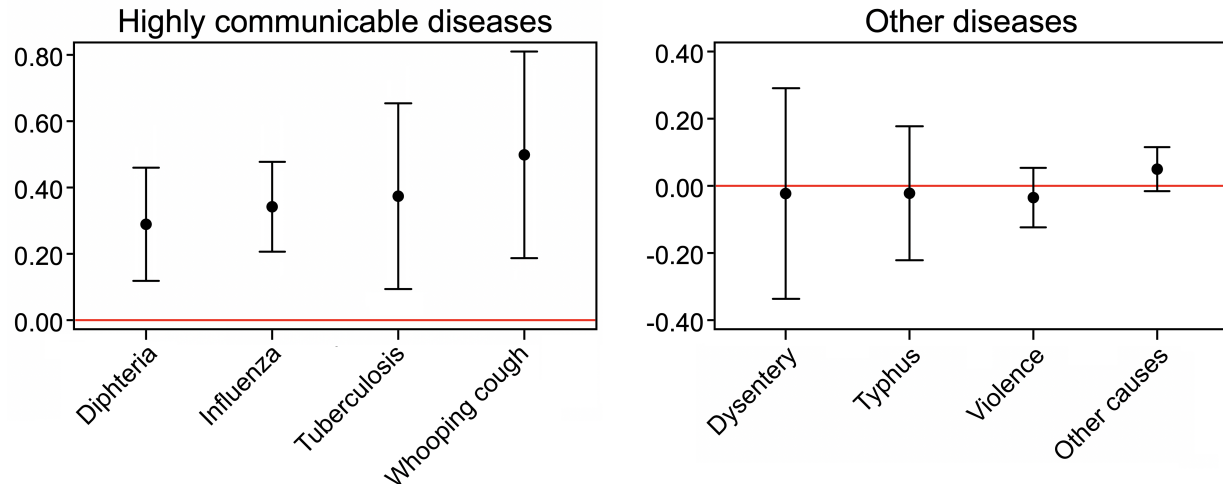
As stated in the x-axis, the outcome variable is death rate from diphtheria (i.e., number of deaths for diphtheria per thousand population), influenza, tuberculosis, whopping cough, dysentery, typhus, violent causes another causes. This is a panel with monthly data from January 1922 to December 1923 with a balanced panel for 280 cities and 9,622 observations. The cost-of-living index is the *Teuerungsraten* index, also expressed in logarithms. All regressions include city and date fixed effects (year-month fixed effects) and are weighted by the size of the city-population with robust standard errors (in parentheses) clustered at the state-level. See equation (1) and text for details on methods

These findings fit with the historical narrative. On influenza, the Medical Official of the Reich reported that "the decline in mortality is, however, initially interrupted in 1922 and 1923 mainly by a repeated strong occurrence of flu as a result of the deterioration in the living conditions of the broadest sections of the population caused by inflation."[6] On other airborne diseases, Winter and Cole (1993: 254) commented how even "the pessimistic view is also supported by data on the increase in respiratory diseases. These indicate that deteriorating work and home conditions, matched by nutritional deficiencies among many parts of the population." On tuberculosis, Medical Official of the Reich also emphasized that "a continuous increase in admissions to tuberculosis clinics has been detected throughout the Reich since 1922 and is still in progress."[7] Jung (2009) reviews that "many young children suffered from deficiency diseases such as rickets, and at times tuberculosis reached almost

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[6] *Beiträge zum deutschen Bevölkerungsproblem. Der Geburtenrückgang im Deutschen Reich Die allgemeine deutsche Sterbetafel für die Jahre 1924-1926*, page 38.

[7] *Über den Gesundbeitszusrand des Deutschen Volkes nach dem Stande von Anfang Januar bis Ende September 1923.*

epidemic proportions. In Mannheim, lung disease was reported in 43 families in one 220-household street alone."

On this trend, Holtfrerich (1986: 264) further added that although a "long winter bore some responsibility . . . this must reflect the general worsening of health conditions associated with deteriorating nutrition and falling real incomes." The American doctor, Esmond R. Long, also made the point that "the rise [in tuberculosis] was so clearly related to the fantastic inflation of 1922-1923 as not to appear a mere coincidence. That increase was considered due in large measure to the high price of food and resultant impaired nutrition" (Long 1948: 273).

Overall, regarding the causes behind these epidemiological changes, the collapse of the economy and subsequent poorer nutrition seems to have played a central role. In the fall of 1923, the Reich Health Office wrote a memorandum emphasizing that coinciding with the hyperinflation months, "a deterioration took place in the standards of nutrition and clothing" with "horrifying and universally evident undernourishment."[8] Ferguson (2010: 209) also reviews how "the 1922 medical reports had shown that every great town in Germany had substantial pockets of desperate undernourishment. Throughout the urban nation, lack of food, clothing and warmth had produced all their concomitant ailments, from ulcers to rickets, from pneumonia to tuberculosis, all pitifully aggravated by the soaring costs of medicines and medical supplies. Another year of infinitely greater deprivation had taken a more terrible toll" (see also Hubbard 1990: 566).

While reading these findings, one needs to be aware that Germany did not lack welfare institutions, particularly since Bismarck had pioneered such things as health insurance, accident insurance, and old-age pensions to wean the working classes away from Social Democracy (Bauernschuster et al., 2020). Bismarck's schemes were pioneering in their day, and some of them, notably the health insurance system, covered millions of workers by the late 19th century. However, such systems became clearly insufficient by 1923 as they were now filled not just with new desperate people but also with previously well-off Germans (Crew 1998; Feldman 1986).

Here the Welfare Department of Hamburg noted that "the galloping inflation, which made it necessary to alter the standard rates over and over again so that they could keep pace with the devaluation of the currency, made it difficult for welfare workers to understand the importance of the standard rates."[9] The report further contends that "By 1923, when the currency completely collapsed, it was no longer possible to do any real social work" but also noted how "the stabilization of the currency gave real social work a new and firmer foundation." At the beginning of December 1923, no less than 22 percent of the people in Munich were on welfare, 39 percent in Frankfurt am Main, 49 percent in Nuremberg, 56 in Stettin and in Dortmund (given its proximity to the Ruhr) 80 percent.[10]

Hubbard (1990: 565) also noted how "indicators of social distress-incidence of disease (morbidity) . . . and number of persons on public relief-rose noticeably after 1918 and peaked in 1923/24." Crew (1998: 11) further argues that during "the inflation of 1918 to 1923. . .

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[8] *Ibid.*

[9] Staatsarchiv Hamburg, SB I VG 24.22, Leitersitzungen, 31 July 1922.

[10] These figures are from *Statistisches Jahrbuchfur das Deutsche Reich*, Vol. 46 (p. 443) and the *Statistisches Jahrbuch deutscher Stadte*, Vol. 22 (p. 441), Vol. 23 (p. 126), Vol. 25 (p. 431), Vol. 26 (p. 333) and Vol. 27 (p. 324).

public welfare became the only means of assistance for the great majority of those in need."[11] About "those in need", Rudolff (1993: 165) contends that the hyperinflation produced a "generalization of poverty ... that gripped social strata that had previously not had to turn in such numbers to the welfare system." A study of welfare clients in Frankfurt am Main made by Dr. Wilh. Niemeyer also found that a significant number of small capital pensioners, civil servants, manufacturers, architects and independent tradesmen were on relief rolls, concluding that "the great bankruptcy of the Reich, which is called the inflation, let them become impoverished, so that we now find them on public welfare" (Niemeyer 1927: 32).

5.3   Robustness checks on Table 1

In Table A2 I remove one of the amenable causes at a time to demonstrate that a particular cause is not driving the results. In Table A3 I also use state-by-time fixed effects that mop up time-varying factors at the state level, absorbing much of the state level redistribution differences. Despite the cost-of-living data display low p-values (statistically significant at the 10 percent level of confidence), the size of the coefficients is substantially reduced (by more than a half). In addition to this, in Table A4 I explore the sensitivity of the results to the chosen functional form and show results without logs (I estimate the model using the level form) and with the hyperbolic sine transformation. In both cases this functional form mitigates the issue of undefined logarithms when mortality rates close to zero and the cost-of-living data continue to display a strong predictive value of the crude death rate.

To further enhance the credibility of the findings I employ a non-parametric estimation approach. I divide the cost-of-living variable into 10 intervals or bins, with one bin (the first one at the bottom of the distribution) serving as the reference category for comparison. Results in Table A5 allows for an examination of whether mortality rates exhibit a continuous increase across the different intervals of cost-of-living data, adding additional evidence that the cost-of-living data is a strong predictive of the mortality.

I also employ a lag-distributed model by incorporating five lags and leads into estimation equation (1). Results in Table A6 show that lags of inflation also affect mortality but only the previous 3-4 months, which is the estimated time duration required for an increase in the cost-of-living to impact mortality rates. For example, perhaps a family could weather the storm if there was just one week of high inflation, but if it was several weeks of inflation, then it starts to cause health problems. By contrast, leads here serve as a sort of placebo test, as higher future prices should not be able to predict current mortality rates.

Finally, since all the results rely on spatial variation, I use a recent implementation of the Conley correction of standard errors for spatial correlation correction to allow for spatial dependence of errors across observations. Conley standard errors allow for spatial autocorrelation within a certain radius around a city with. Table A7 shows the standard errors for table 1 for different cut-offs of spatial dependence. The distance used to calculate these standard errors is the Euclidian distance between any two cities allowing for standard errors to be correlated within a radius of that distance at 100, 200, and 300 km. Whether or

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[11]He also notes that, "in the mid-1920s, the numbers of Germans who had to turn to public welfare decreased considerably."

not geography plays an important role in this setting, these corrections does not materially affect the baseline results of table 1.

6   Anthropometric evidence

While in the previous section, I showed that people and infants suffered more in places where hyperinflation was higher and this led to higher mortality, especially deaths from amenable causes, it is possible to map further the epidemiological changes and the results on mortality in Table 1, examining the drivers between prices, nutrition, and disease by looking at the children's weights and heights as a measure of chronic malnutrition and sustained disease burden.[12] When considering the significance of both anthropometric measurements, weight can be seen as a more immediate measure of nutritional status than height. In the absence of adequate nutrition, a child first slows in weight gain, and finally, if the deprivation is of long enough duration, stature is also affected. I also prefer to look at height and weight indicators separately. In a setting like this, the body mass index, a combination of both height and weight, may conflate long- and short-term health changes.

Here, I rely on the data and analysis presented by Cox (2019) to show mean weight and height of children measured from 1916 to 1924 at the ages between 6 and 19. The data are based on nearly 600,000 schoolchildren from 19 cities. Unfortunately, data for 1915 is missing[13] and the only data that survived and was collected by Cox are the summary statistics of the school means, which includes a total of 2,343 different school classes, rather than the individual data cards. These are available in the Deutsches Hygiene Museum of Dresden (*Grösse und Gewicht der Schulkinder*).

Given the large sample size and the type of source (primary school records from representative schools of the German society) selection bias on unobservables are unlikely (Schneider 2020).[14] Cox (2019: 203) also mentions heterogeneity across the territory, and that "the timing of that deprivation, and of children's recovery, varied depending on the type of school they attended." Next, I present the results obtained by Mary E. Cox, who used OLS regression analysis to isolate the background characteristics of the children. In her analysis, children's heights and weights were regressed on age, social class, year of measurement, location, and interactions of social class with the years displayed on the horizontal axis relative to 1914. In other words, the first year of the war is used as a baseline, before any major impacts of the war.

Figure 2 display height-for-age z-scores (HAZ), and weight-for-age z-scores (WAZ), measuring position relative to the modern WHO reference, indicating a downward trajectory of WAZ scores from 1916 to 1918, with recovery achieved in 1920. The WAZ scores in 1921 and 1923 were higher than those in 1914. HAZ scores, on the other hand, show a much slower path of recovery, and a pattern of reduced height continued through 1923, well after the war

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[12]There is always a short delay, as when nutritionally deprived body receives extra calories, it allocates those calories to maintain bodily organs rather than to accelerate growth in stature.

[13]Cox (2019: 617) says that "data for 1915 are not included because they were not recorded at the time, a singular lapse that likely reflects the exigencies of the war."

[14]Cox (2016: 604) argues that "school attendance had been compulsory for over 30 years in Germany at the time these data were collected. This prevents sample selection bias of the nature probably found in military and prison data, and ensures a distribution of children from across social classes.

had ended. These trends likely reflect the end of the war and the lifting of the blockade in 1919. When foreign imports resumed, calories became available, allowing stunted children to increase in weight before they increased in stature. The year of greatest weight and height loss relative to 1914 was 1918 but coinciding with the hyperinflation, during the fall of 1923, 1924 showed a significant decline in HAZ and WAZ scores, being below or similar to those in 1914. On these developments, Ferguson (2010: 118) adds that already "the figures issued by the chief burgomaster of Pankow for 1922 showed that nearly 25 per cent of the children leaving school were below the normal spread of weights and heights, and 30 per cent were unfit to work for reasons of health."

Cox's analysis stops in 1924, and after that, data are less available. Nonetheless, the medical report by Dr. Georg Wölff (Director of Health Department of the city of Berlin) provides mean heights and weights of school children aged 5 and a half to 7 years old (with their associated standard errors) for the years 1924 and 1928. These measurements were taken from the school district of Berlin-Prenzlauer Berg. The investigations took place in the spring of each year and were part of regular medical check-ups of the children, including 1,966 boys and 1,873 girls who participated in the five-year program. In Table A8, I reproduce the statistics reported by Wölff (1930), highlighting that children's net nutritional status enjoyed a monotonic upward trend after 1924, emphasizing the abnormal nutritional situation of 1924 and reflecting the extraordinary negative experience of the German hyperinflation in terms of health.

Figure 2. Height-for-age and Weight-for-age Z-scores, 1914-1924
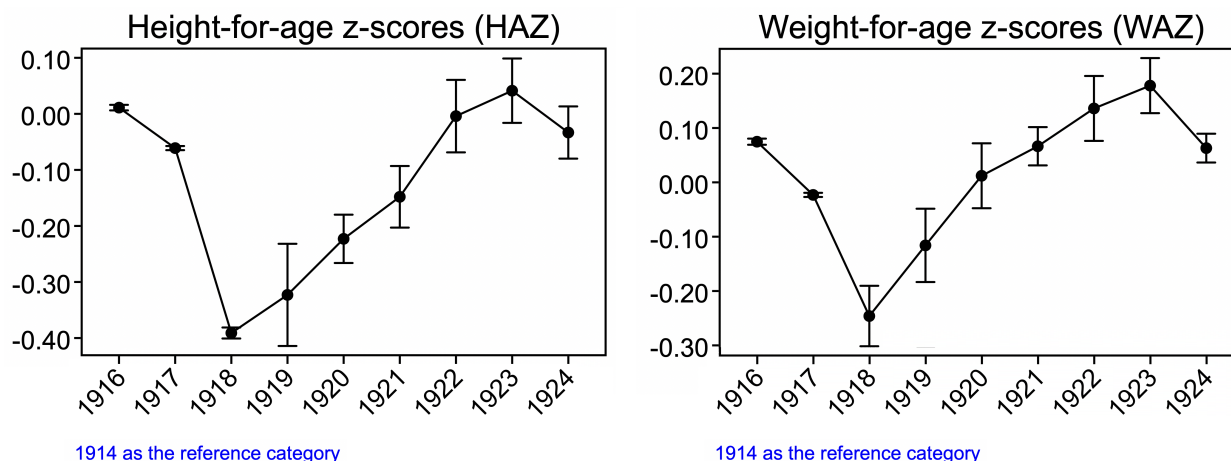
These two graphs show children's HAZ and WAZ values regressed on age, social class, year of measurement, location, and interactions of social class with the years displayed on the horizontal axis relative to 1914. The first year of the war is used as a baseline, before any major impacts of the war. 1915 was not included in the sample as data are not available. These graphs use the tabular details in Cox (2016) tables 5 and 6 (pages 613 and 614). For more details see Cox (2016).

Overall, while the causes of child stunting are still multidimensional, ranging from inadequate nutrition to repeated disease insults, it is possible to argue that a poor diet lacking in calories, protein, or other micronutrients at early ages clearly matters and is linked to

the collapse of the economy. Mounting evidence also suggests that sources of animal protein in the diet may be particularly important in preventing children from growing too slowly and combating diseases. Naturally, there is a complex inter-relationship between nutrition and morbidity, and while having low nutritional status could make children more susceptible to certain diseases and more serious illness, there is also a potential straight line between diseases and reduced nutritional status.

In 1923, the short-lived negative shock came from impaired nutrition due to hyperinflation and falling incomes, and the collapse of the economy led to undernutrition and starvation, which made Germans weaker and more likely to succumb to infectious and communicable diseases and die, rather than creating other conditions in the first instance that helped these diseases spread and affect nutrition. Anthropometric records after 1924 further show that health rapidly resumed after the hyperinflation experience. This point is also shared by Teuteberg and others, who argue that food situation was really compromised in 1923 due "to the hyper-inflation which reduced wages, salaries and other income" and that "only with the introduction of a new currency at the end of 1923 and the subsequent return to the free market system was it possible for Germany to gradually restore normal feeding" (Teuteberg 2011: 70).

7   Concluding remarks

The hyperinflation that occurred in Germany in the fall of 1923 was the defining episode of the 20th century shaping European monetary policy, and one of the most severe economic crises in modern history, with the inflation rate soaring to over a trillion percent and leading to the collapse of the German currency and severe economic disruption. It was a devastating monetary shock that had far-reaching effects on the labor market, society, and public health. Statistical modeling based on panel data with fixed effects shows that a one-standard-deviation increase in the cost-of-living data is associated with an increase in the crude death rate (in standard deviation terms) of between one quarter or one third of one standard deviation (depending on how mortality is measured).

The impact of the hyperinflation on the material lives of Germans was a wave of starvation that afflicted first those at the bottom of income distribution, and at its end, engulfed the entire population including the upper classes. The new epidemiological framework stemming from impaired nutrition led to a surge in infectious and communicable diseases like influenza and tuberculosis, where everyone, the poor, the working class, and the owners of capital, were more exposed to get ill and die.

While in studies like this using observational data it is always difficult to establish a neat direct causal relationship, this paper has endeavored to provide not just anecdotal but statistical evidence that the economic and social disruptions caused by the hyperinflation contributed to worsening health. However, before interpreting these findings further, I need to note a couple of potential limitations. First, due to data availability, I am unable to adjust for age at the city levels, creating potential for error. However, city-level fixed effects would adjust for any time-invariant characteristics of the age distribution. Second, on endogeneity and reverse causality, I have been unable to find a suitable instrument and it is also possible that a third underlying factor drove both price and mortality rises. For instance, beyond the

historical narrative on Bismarck's social security, I have not been able to evaluate the role of welfare payments to buffer economic suffering, which may have acted as a confounder. Nonetheless, fixed effects help to attenuate this worry, and from the reading of history, it seems clear that by the fall of 1923 the social scheme provided by the Weimar Republic was already in collapse

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Table A1. Descriptive statistics

	N	Mean	Std. Dev.	Min	Max
Inflation data (in logs)					
Cost-of-living index	9,622	11.206	5.929	6.587	32.525
Mortality statistics (per thousand population)					
Crude death rate	9,622	17.307	34.386	1.667	84.812
Infant mortality rate	9,622	113.354	7.475	30.319	284.193
Amenable mortality rate	9,622	6.974	6.268	0.356	77.781
Cause-specific deaths (x100,000 population)					
Diphtheria	9,622	7.357	17.289	0.024	187.512
Influenza	9,622	20.296	52.791	0.294	687.521
Tuberculosis	9,622	140.5887	82.63	0.107	604.671
Whooping caught	9,622	5.658	15.872	0.081	266.657
Dysentery	9,622	3.843	37.131	0.195	156.573
Typhus	9,622	4.918	17.247	0.942	464.781
Violence	9,622	64.198	88.249	84.192	6,217.39
Other causes	9,622	772.391	282.529	338.213	2523.809

For sources and definitions see text (Section 4).

Table A2. Panel data for the impact of hyperinflation on mortality (one cause out)

	Reference	Influenza	Scarlet	TB	Whooping	Meningitis
	(1)	(2)	(3)	(4)	(5)	(6)
Cost-of-living (in logs)	0.363***	0.390***	0.380***	0.402***	0.315***	0.365***
	(0.096)	(0.142)	(0.090)	(0.098)	(0.099)	(0.094)
Observations	9,622	9,622	9,622	9,622	9,622	9,622
Year-month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
City fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Population weighted	Yes	Yes	Yes	Yes	Yes	Yes

Outcome variable is the crude death rate from amenable causes (the reference category in table 1 column 3) once deducting the cause listed in the table (columns 2-6) and in logs. This is a panel with monthly data from January 1922 to December 1923 with a balanced panel for 280 cities. The cost-of-living index is the *Teuerungsraten* index, also expressed in logarithms. All regressions include city and date fixed effects (year-month fixed effects) and are weighted by the size of the city-population with robust standard errors (in parentheses) clustered at the state-level. See equation (1) for details on methods, *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table A3. Panel data for the impact of hyperinflation on mortality with state-by-time fixed effects.

	Infant mortality	Adult mortality	Amenable mortality
	(1)	(2)	(3)
Cost-of-living (in logs)	0.013*	0.050*	0.220**
	(0.060)	(0.022)	(0.109)
Observations	9,622	9,622	9,622
State-year-month fixed effects	Yes	Yes	Yes
Population weighted	Yes	Yes	Yes

Outcome variable is infant mortality, adult mortality and amenable mortality as stated in the table and in logarithms. The variable amenable mortality combines the total number of deaths from influenza, meningitis, scarlet fever, tuberculosis, and whooping cough per thousand population. This is a panel with monthly data from January 1922 to December 1923 with a balanced panel for 280 cities. The cost-of-living index is the *Teuerungsraten* index, also expressed in logarithms. All regressions include state-by-month-year fixed effects and are weighted by the size of the city-population with robust standard errors (in parentheses) clustered at the city-level, *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table A4. Panel data for the impact of hyperinflation on mortality

	Without logs			Hyperbolic sine transformation		
	Infant	Adult	Amenable	Infant	Adult	Amenable
	(1)	(2)	(3)	(4)	(5)	(6)
Cost-of-living	2.874**	44.952*	84.863**	0.024**	0.143**	0.089***
	(1.101)	(26.153)	(39.620)	(0.010)	(0.056)	(0.028)
Observations	9,622	9,622	9,622	9,622	9,622	9,622
Year-month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
City fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Population weighted	Yes	Yes	Yes	Yes	Yes	Yes

Outcome variable is infant mortality, adult mortality and amenable mortality as stated in the table and in logarithms. The variable amenable mortality combines the total number of deaths from influenza, meningitis, scarlet fever, tuberculosis, and whooping cough per thousand population. This is a panel with monthly data from January 1922 to December 1923 with a balanced panel for 280 cities. The cost-of-living index is the *Teuerungsraten* index, also expressed in logarithms. All regressions include city and date fixed effects (year-month fixed effects) and are weighted by the size of the city-population with robust standard errors (in parentheses) clustered at the state-level. For the hyperbolic sine transformation, I use the *ihstrans* command in stata, that generate inverse hyperbolic sine transformed variables out of a list of multiple variables, *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table A5. Panel data for the impact of hyperinflation on mortality (in logarithms) dividing the cost-of-living variable into 10 intervals or bins.

	Bin 2	Bin 3	Bin 4	Bin 5	Bin 6	Bin 7	Bin 8	Bin 9
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Infant mortality	0.010***	0.024***	0.026***	0.037***	0.043***	0.049***	0.057***	0.068***
	(0.004)	(0.011)	(0.012)	(0.013)	(0.013)	(0.013)	(0.014)	(0.015)
Adult mortality	0.051	0.125	0.175***	0.264***	0.339***	0.377***	0.456***	0.494***
	(0.036)	(0.075)	(0.075)	(0.095)	(0.109)	(0.112)	(0.105)	(0.110)
Amenable mortality	0.068	0.377***	0.348***	0.550***	0.886***	0.996***	1.209***	1.409***
	(0.051)	(0.161)	(0.171)	(0.197)	(0.286)	(0.301)	(0.316)	(0.366)

The reference category is the first decile (Bin 1). Each model includes the 9622 observations. Outcome variable is infant mortality, adult mortality and amenable mortality. The variable amenable mortality (last graph) combines the total number of deaths from influenza, meningitis, scarlet fever, tuberculosis, and whooping cough per thousand population. This is a panel with monthly data from January 1922 to December 1923 for a balanced panel for 280 cities. The cost-of-living index is the *Teuerungsraten* index, also expressed in logarithms. All regressions include city and date fixed effects (year-month fixed effects) and are weighted by the size of the city-population with robust standard errors (in parentheses) clustered at the state-level. The cost-of-living variable is divided into 10 intervals or bins, with one bin (the first one at the bottom of the distribution) serving as the reference category for comparison, *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table A6. Lag-distributed panel data for the impact of hyperinflation on mortality (in logarithms)

	Lead 5	Lead 4	Lead 3	Lead 2	Lead 1	Ref.	Lag 1	Lag 2	Lag 3	Lag 4	Lag 5
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Infant mortality	0.00	0.00	0.01	0.02*	0.02**	0.02**	0.01	0.01	0.01	0.01	0.00
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Adult mortality	0.00	0.00	0.03	0.10*	0.11**	0.14**	0.06	0.05	0.06	0.04	0.04
	(0.06)	(0.06)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.06)	(0.06)	(0.07)	(0.07)
Amenable mortality	-0.05	0.05	0.21***	0.31***	0.34***	0.36***	0.22*	0.16	0.13	0.01	-0.06
	(0.10)	(0.09)	(0.09)	(0.09)	(0.10)	(0.10)	(0.12)	(0.11)	(0.10)	(0.12)	(0.13)

Outcome variable is infant mortality, adult mortality, and amenable mortality. The variable amenable mortality (last graph) combines the total number of deaths from influenza, meningitis, scarlet fever, tuberculosis, and whooping cough per thousand population. This is a panel with monthly data from January 1922 to December 1923 for a balanced panel for 280 cities. The cost-of-living index is the Teuerungsraten index, also expressed in logarithms. All regressions include city and date fixed effects (year-month fixed effects) and are weighted by the size of the city-population with robust standard errors (in parentheses) clustered at the state-level. Point estimates are confidence intervals reflect that this is a lag-distributed model that incorporates five lags and leads into estimation equation (1), *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table A7. Panel data for the impact of hyperinflation on cause-specific mortality with standard errors corrected for spatial dependence.

	Infant mortality			Adult mortality			Amenable mortality		
	100 km	200 km	300 km	100 km	200 km	300 km	100 km	200 km	300 km
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Cost-of-living	0.024***	0.024***	0.024***	0.143***	0.143***	0.143***	0.363***	0.363***	0.363***
(in logs)	(0.009)	(0.011)	(0.006)	(0.051)	(0.054)	(0.058)	(0.108)	(0.112)	(0.040)
Observations	9,622	9,622	9,622	9,622	9,622	9,622	9,622	9,622	9,622

Outcome variable is infant mortality, adult mortality and amenable mortality as stated in the table and in logarithms. The variable amenable mortality combines the total number of deaths from influenza, meningitis, scarlet fever, tuberculosis, and whooping cough per thousand population. This is a panel with monthly data from January 1922 to December 1923 with a balanced panel for 280 cities. The cost-of-living index is the *Teuerungsraten* index, also expressed in logarithms. All regressions include city and date fixed effects (year-month fixed effects) and are weighted by the size of the city-population with Conley standard errors (in parentheses) clustered at the state-level and correction for spatial dependence as stated in the table. See equation (1) for details on methods, *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table A8. Height in cm and weight in kg of school children 1924-1928.

Ages	1924	1925	1926	1927	1928
Height (boys)					
5 ½- 6	106.63 ± 0.459	107.25 ± 0.494	108.82 ± 0.347	111.11 ± 0.382	111.33 ± 0.420
6 - 6 ½	108.69 ± 0.464	110.02 ± 0.385	110.58 ± 0.321	113.61 ± 0.342	113.72 ± 0.401
6 ½ - 7	108.93 ± 0.293	110.23 ± 0.342	110.90 ± 0.686	113.33 ± 0.578	113.91 ± 0.928
Height (girls)					
5 ½- 6	105.95 ± 0.486	107.32 ± 0.572	108.25 ± 0.335	111.00 ± 0.345	110.57 ± 0.449
6 - 6 ½	107.97 ± 0.417	109.50 ± 0.435	110.06 ± 0.303	113.68 ± 0.327	113.07 ± 0.397
6 ½ - 7	110.04 ± 0.730	110.22 ± 0.629	111.19 ± 0.677	113.65 ± 0.640	112.85 ± 0.781
Weight (boys)					
5 ½- 6	18.65 ± 0.203	18.54 ± 0.202	19.02 ± 0.152	19.17 ± 0.163	19.31 ± 0.175
6 - 6 ½	19.19 ± 0.171	19.70 ± 0.180	19.72 ± 0.138	19.86 ± 0.149	20.26 ± 0.180
6 ½ - 7	19.52 ± 0.293	19.39 ± 0.342	19.64 ± 0.323	19.46 ± 0.301	20.11 ± 0.418
Weight (girls)					
5 ½- 6	17.87 ± 0.194	18.64 ± 0.297	19.08 ± 0.190	19.09 ± 0.183	19.38 ± 0.259
6 - 6 ½	18.36 ± 0.200	19.14 ± 0.200	19.54 ± 0.154	19.98 ± 0.182	19.66 ± 0.191
6 ½ - 7	18.79 ± 0.263	19.07 ± 0.281	19.43 ± 0.319	19.36 ± 0.283	19.94 ± 0.480

Height was recorded in cm and weight in kg. For more details on data and sources see Wölff (1930, Tab. 2).

Documentos de Trabajo EH-Valencia

2023

01   *The Spanish municipal population database (ESPOP) 1860-1930.*
Francisco J. Beltrán-Tapia, Alfonso Díez-Minguela, Julio Martinez-Galarraga, Daniel A. Tirado Fabregat.

02   *Scarring through the German hyperinflation*
Gregori Galofré-Vilà.

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