

Health and welfare in Western Europe, 1900-1950

Daniel Gallardo Albarrán

University of Groningen

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Abstract

The improvement in world living standards during the last two centuries has been remarkably uneven across countries and time. For instance, whereas the post-1945 years stand out as a period of fast-growing living standards, the world economy struggled throughout the first half of the 20th century. This slowdown was partially because armed conflicts, protectionism and economic crises had a strong negative impact on European economies which generated almost 50 percent of world income in 1900. On the other hand, this low economic performance highly contrasts with the evolution of health that during this period exhibited the largest improvement in life expectancy in European history. To assess the evolution of European well-being during the period 1900-1950, this paper accounts for different trends and levels in income and health by applying a composite indicator grounded on economic theory to a sample of 12 Western European countries and the United States during the period 1900-1950. The main results can be summarized as follows. Firstly, income's underestimation in living standards ranges from 2.8 to 6.2 percent in Sweden and Spain respectively. For Western Europe as a whole, yearly welfare grew by 4.7 percent in contrast with an income per capita growth of 1.2 percent. Also, the dynamics of welfare differ with income in that average income levels increased most rapidly in the 1920s and declined in the 1930s, while welfare growth peaked in the period leading up to WWI and kept growing throughout the Great Depression. Secondly, in terms of levels North-Western Europe loses the lead in favour of Northern Europe due to lower levels of health and consumption share over GDP, and Southern Europe shows sign of strong convergence in the 1920s and 1930s. If we look at Western Europe as a whole, we observe that welfare levels relative to the United States did not deteriorate in the long-run as indicated by income per capita. And thirdly, I find weak evidence of welfare convergence over this period although it is largely driven by three countries.

1 Introduction

The improvement in world living standards during the last two centuries is beyond dispute. Today's world citizens live longer, healthier and are better nourished than their counterparts at any time of human history. In terms of income per capita, a world citizen is almost eight times better off nowadays than in 1870 (Bolt & van Zanden, 2014). Over time, this process has not followed a unique pattern as its pace varied significantly across continents, countries and even regions. For instance, whereas the post-1945 years stand out as a period of fast-growing living standards, the world economy barely reaches an annual income growth of one percent during the first half of the 20th century. One of the reasons for this slowdown are the international disruptions caused by the effect and persistence of large-scale armed conflicts and economic crises, which had a particularly strong impact on the region that in 1913 generated almost 50 percent of world income, namely Europe (Roses & Wolf, 2010).

During this period, major disruptive events such as two world wars, civil wars or the Great Depression hit severely European countries. As a result, many European countries struggled throughout this period exhibiting low growth rates of income per capita, whereas other countries less affected by these happenings such as Canada and the United States grew more than two times faster (Bolt, Inklaar, de Jong, & van Zanden, 2015). On the other hand, this low economic performance highly contrasts with the evolution of other well-being dimensions such as leisure, political freedom (especially for women) or most remarkably health (Huberman & Minns, 2007; Aidt, Dutta, & Loukoianova, 2006; Cutler, Deaton, & Lleras-Muney, 2006). During this period, rising nutrition levels as well as the spread of new medical knowledge and their influence on households' hygienic habits and investment in sanitary infrastructures contributed to improve citizen's health substantially (Mokyr & Stein, 1997; Cutler & Miller, 2005; Fogel, 1994). These factors made possible that Europeans witnessed the most impressive increases in life expectancy at birth in their history (20 years on average) in the analysed time period (Riley, 2005). Furthermore, health indicators are not only at odds with the development of well-being portrayed by income measures, but they also suggest that comparative levels of living standards look significantly different. Whereas some countries might be performing relatively well in terms of health, the same might not be the case in terms of income.

The contrasting evidence from the health literature suggests two important issues related to the measurement of well-being with income per capita during the period 1900-1950 in Europe. The first is that welfare growth would be seriously underestimated, if we ignore the largest health improvements in history for this region. And the second is that welfare differences across countries assessed exclusively by income per capita would provide a one-sided

picture as health measures provide a different ranking. Therefore, to offer a more complete account of the evolution of European welfare during this period this research proposes to focus on a sample of twelve Western European countries with very high quality data to combine the income and health dimension by employing a composite indicator.¹

The most well-known composite indicator is probably the Human Development Index (HDI) that combines income, education and health (UNDP, 1990). Since its creation, this measure has been applied to a large variety of countries and historical periods including Western Europe and the period 1900-1950 (Crafts, 1997, 2002; Prados de la Escosura, 2015).² However, the use of HDI and similar indicators has been criticised for scientific analyses due to its arbitrary weighting scheme (Nordhaus, 2003, 27). Especially during the first half of the 20th century, this issue takes on greater importance because dimensions with very diverse growth rates can drive upwards or downwards the development of the welfare indicator depending on the weight given to each dimension.

To overcome the weighting problem, this research will take an approach in line with economic theory and will develop a consumption-equivalent measure to combine the dimensions of income and health drawing on Jones and Klenow (2016). Contrary to the HDI that aggregates income and health separately with equal weight, this new welfare measure recognises that lower mortality rates magnify growth (or cross-country differences) in consumption, since a typical person is more likely to survive and enjoy this extra consumption. By applying this indicator to twelve Western European countries and the United States³ during the first half of the 20th century, this research aims at contributing to the literature in three ways. Firstly, I will provide country-specific estimates of the extent to which income per capita is underestimating welfare increases when health is accounted for. Secondly, with the new indicator I provide a full account of the welfare dynamics by decade, which are neglected by some studies in the literature (Crafts, 1997, 2002; Hickson, 2009). And thirdly, for the first time I provide comparative welfare levels for a historical time period taking a utility approach.

The main findings of this exercise can be summarised in three points. Firstly, income's underestimation in living standards ranges from 2.8 to 6.2 percent in Sweden and Spain respectively. For Western Europe as a whole, yearly welfare grew by 4.7 percent in contrast

¹As Easterlin (2000) points out, the concept of the standard of living is a multidimensional one that income, health, social or political aspects among others. In the remaining of the paper, I will use the terms well-being, living standards or welfare indistinctly to refer to the joint consideration of income and health dimensions.

²It should be noted that Prados de la Escosura (2015) used a variation of the HDI by transforming non-income dimensions. This transformation is aimed at reflecting that an increase in the dimensions of health or education represents a bigger achievement in the standard of living of a country with high initial levels.

³I included the United States to provide a comparative perspective beyond Europe.

with an income per capita growth of 1.2 percent, almost four times faster. Whereas income per capita suggests a doubling of the average welfare level every 60 years, the new welfare measure points to a doubling every 15 years (almost a fourfold increase over this period). Also, the dynamics of welfare differ with income in that average income levels increased most rapidly in the 1920s and declined in the 1930s, while welfare peaked in the 1910s and kept growing throughout the Great Depression. Within Western Europe, the fastest-growing region in terms of welfare is not North-Western Europe but Southern Europe. Secondly, in terms of levels North-Western Europe loses the lead in favour of Northern Europe due to lower levels of health and consumption share over GDP and Southern Europe shows signs of strong convergence in the 1920s and 1930s. If we look at Western Europe as a whole, we observe that welfare levels did not deteriorate in the long-run as indicated by income per capita. As a result, the welfare difference between a typical Western European and an American was roughly the same throughout this period, namely almost two thirds of the American level. And thirdly, I find weak evidence of welfare convergence over this period largely driven by three countries.

The paper is organised as follows. The next section reviews a selection of relevant studies in the field of living standards measurement. The third section explains the methodology employed for time and cross-sectional well-being comparisons. The fourth section provides a descriptive analysis of the evolution of living standards over the period 1900-1950 for the dimensions of income and health separately, and it also presents the data that will be used in the model. The fifth section presents the results for a selection of countries and the sixth section concludes.

2 Literature review

The literature on the measurement of living standards is unsurprisingly vast. For practical reasons, in this section I will focus on the strand of this literature that deals with (although not exclusively) the development of Western European and American living standards during the first half of the 20th century in a multi-dimensional manner.⁴ For this purpose, a common approach is the Human Development Index (HDI), which was developed in the United Nations Development Program (UNDP, 1990) and considers three key dimensions of welfare, namely income, education and health. To combine them, each dimension is transformed into index form by using their observed maximum and minimum values. The final indicator is obtained by taking the geometric average for the three dimensions and can be interpreted as the distance of a certain country from the maximum current attainable values in its three

⁴This section is complemented below by considering the dimensions of income and health separately.

components.⁵

Three studies that apply this methodology to Western Europe and the United States during the analysed time period are worth mentioning. The first two are Crafts (2002), that assesses well-being developments worldwide for the period 1870-1990, and Millward and Baten (2010) which focuses on Europe for the period 1913-1938. The main conclusions in these studies are similar in that both show high growth rates during the first half of the 20th century, especially in Southern Europe. This results in a strong welfare convergence of Southern Europe with its neighbouring countries mainly driven by rapid catch-up in the dimensions of health and education. Regarding welfare levels, cross-country differences in the leading regions are very low in 1913 and even lower in 1950 as shown by the maximum percentage HDI gap with maximum values of ten and six percent respectively (Crafts, 2002, 396-397).⁶ A further interesting conclusion concerns the relative position of Western European countries with respect to the United States, since American leadership only becomes clear after the second world war. Considering Western Europe as a whole though, the United States is slightly ahead in 1913 and 1950. The third study is Prados de la Escosura (2015) adjusts the HDI by applying a non-linear transformation to the dimensions of health and education. This transformation is aimed at reflecting that an increase in these dimensions represents a bigger achievement in the standard of living of a country with high initial levels (e.g. a marginal increase in life expectancy at the age of 80 would represent a larger achievement than at the age of 40). The author finds similar results as the previous studies for well-being growth rates. In terms of levels, the American leadership is not that clear since the Netherlands is slightly ahead in 1950.

Despite these articles draw similar conclusions in terms of welfare levels, growth rates and convergence within Western Europe, these must be interpreted with caution because the indicator employed is the same or very similar. The HDI is useful for long-term welfare comparisons because it incorporates key dimensions of well-being and historical data for these dimensions are relatively easy to obtain for a large number of countries. Nevertheless, an important part of the literature on the measurement of living standards has criticised this indicator in the last two decades for (among other things) equally weighting its three dimensions.⁷ This weighting scheme is considered to be arbitrary since it is not theoretically-grounded, which makes its use difficult for a thorough scientific analysis (Nordhaus, 2003, 20).

To overcome the weighting problem, another stream of the literature has worked in a

⁵See UNDP (2010) for a more comprehensive explanation.

⁶The interpretation of HDI levels must be made with caution since this indicator is rather used for ranking countries.

⁷See Klugman, Rodriguez, and Choi (2011) for an overview of 'old' and new critiques.

different direction by employing a utility framework to combine different well-being dimensions.⁸ The seminal work by Usher (1973) represents the first attempt to combine income and health by incorporating gains in mortality to GNP. In his work, he calculated welfare growth rates for France (and other non-European countries) for the period 1911-1964 and showed that welfare growth can be revised upwards up to 40 percent. Usher's study triggered a wave of new research in this direction such as Crafts (1997). In this paper, the author develops a welfare measure that includes income, health and leisure for a large number of countries from 1870 to 1992. During the first half of the 20th century, Crafts estimates that welfare growth rates in Western Europe might have been two or three times as large as what GDP per capita suggests.⁹ Despite Crafts' paper is certainly a benchmark in this literature and represents an improvement in theoretical terms from other HDI-based studies, it does not suffice for comprehensively studying welfare developments in Western Europe during the period 1900-1950 for three reasons. Firstly, the analytical framework employed in Crafts (1997) only allows for estimating welfare growth rates. This leaves a number of questions unanswered regarding relative well-being levels between different regions in Western Europe (and the United States) and the existence of welfare convergence at the end of the period. Secondly, Crafts's analysis does not pay particular attention to the welfare dynamics within the first half of the 20th century by looking at the period 1913-1950. And thirdly, to measure the contribution of health to well-being Crafts used life expectancy at birth and therefore did not take into account the distribution of mortality across different ages. In a period with significant reductions in infant and child mortality like the first half of the 20th century, this can result in large life expectancy increases mainly driven by mortality developments at the youngest ages and therefore further data and analyses are needed to quantify this effect.

All in all, a complete picture of the development of Western European well-being for the period 1900-1950 can only be obtained by applying a framework that allows for growth rate, level and convergence analyses. Such a framework is proposed by Jones and Klenow (2016) which develops an income-equivalent measure that combines income, health, leisure and inequality to examine welfare differences across countries and time for the period 1980-2007. In this study, I draw on their framework to combine the well-being dimensions of income and health.

⁸Another approach to deal with the weighting scheme issue is data-driven. By using principal components analysis, one can create a composite indicator from the shared information of its different dimensions. See Rijpma (2014) for an analysis of global well-being since 1820 using this methodology.

⁹Improved versions of Usher's model have been developed and applied exclusively to the United States by Nordhaus (2003) and Murphy and Topel (2006). Their results indicate that accounting for health can increase welfare growth from 50 to 100 percent.

3 Methodology¹⁰

3.1 Cross-sectional comparisons

To compare welfare across countries with different levels of income and health, we first need a consistent way of valuing them. This is specially important in a comparative utility-based approach, since citizens preferences can differ across countries and over time, and taking into account heterogeneous preferences can result in countries having similar welfare levels despite having different levels of income or health. In this paper, I follow Jones and Klenow (2016) by considering a representative individual that will have a given set of fixed preferences, with which welfare will be compared across countries and over time. This individual lives behind a veil of ignorance and she does not know in which country she will live for her whole life, what her income level will be or the health status she will have.

To value an individual's satisfaction, I define the expected lifetime utility for an individual as follows:

$$U = \mathbb{E} \sum_{a=1}^{110} \beta^a u(C_a) S(a) \quad (1)$$

where $S(a)$ is the probability that the individual is alive up to age a , β^a is the discount rate and C_a is the individual's annual consumption. At this point, it is important to clarify what aspect of the health dimension I am measuring. Murphy and Topel (2006) argues that health-related knowledge can affect the quality and (or) the quantity of life. With $S(a)$, I am mainly measuring improvements that affect the quantity of life (i.e. mortality). On the other hand, one could also argue that mortality rates at young ages can also capture some aspects of the quality of life because children are more vulnerable than adults to the disease environment. Nevertheless, measuring improvements in the quality of life is beyond the scope of this paper¹¹ and therefore I will assume that lower mortality rates enhance well-being by allowing individuals to live longer and enjoy consumption for a longer period of time.

To assess differences in living standards across countries with this methodology, two further steps need to be taken. The first one consists of extending Equation 1 as follows:

$$U_i(\lambda) = \mathbb{E}_i \sum_{a=1}^{110} \beta^a u(\lambda C_{ai}) S_i(a) \quad (2)$$

where the subscript i refers to a certain country and λ multiplies consumption. $U_i(\lambda)$ then

¹⁰This section largely draws on Jones and Klenow (2016). For this reason, I use their mathematical notation.

¹¹See Murphy and Topel (2006) for such an attempt.

is the expected lifetime utility of an individual in country i when consumption is multiplied at every age by λ . The second step involves choosing a benchmark country with which welfare comparisons will be made. For this purpose, I chose the United States given its high performance in health and specially income over the period 1900-1950.

Taking the United States as a benchmark, we can think of welfare differences between countries in two ways. The first is the so called equivalent variation which answers the question: by which factor (λ_i^{ev}) must an individual's consumption as a random person in the United States be adjusted so that he is indifferent between living there and in country i ? And the second way is the the compensating variation which gives an answer to the question: by which factor (λ_i^{cv}) must an individual's consumption in country i be adjusted so that it reaches the U.S. level?¹² Formally, the two answers can be expressed as follows:

$$\begin{aligned} U_{us}(\lambda_i^{ev}) &= U_i(1) \\ U_{us}(1) &= U_i(\lambda_i^{cv}) \end{aligned} \tag{3}$$

To apply this theoretical framework, we first need to choose the function that will determine an individual's welfare as follows:

$$u_i(C) = \bar{u} + \log C_i \tag{4}$$

where $\log C_i$ is log-transformed consumption in country i ¹³ and \bar{u} is the utility of just being alive. This functional form is intuitive in that if consumption is very low or zero, the individual still finds utility in other things in life. Moreover, consumption shows diminishing returns (this assumption is also taken by other methodologies such as the HDI).

To obtain the expected lifetime utility for an individual in a certain country, Equation 4 can be extended in the following way:¹⁴

¹²Technically, the welfare measure developed in this section is a consumption-equivalent indicator because it calculates the amount of consumption that has to be given or taken away to make an individual indifferent between two situations. However, for the sake of simplicity in the remaining of this paper I will refer to this consumption-equivalent measure simply as *welfare*, *well-being* or *living standards*.

¹³The consumption component in this function is of the CRRA form (Constant Relative Risk Aversion) with a risk aversion parameter of one. The CRRA utility function is:

$$u(c) = \begin{cases} \frac{1}{1-\theta} c^{1-\theta} & \text{if } \theta > 0, \theta \neq 1 \\ \ln c & \text{if } \theta = 1 \end{cases}$$

where θ is the risk aversion parameter. When θ equals one then the function is reduced to $\log C$ by applying the L'Hôpital rule. For the calculations, I use a value of one for θ .

¹⁴In the Appendix, I develop the model in a simpler way that allows for using life expectancy figures, that are significantly easier to obtain for a broad cross-section of countries, instead of age-specific survival rates.

$$U_i = \left[\sum_{a=1}^{110} \beta^a S_i(a) \right] \cdot (\bar{u} + \log c_i) \quad (5)$$

With this formula, we can now obtain λ_i^{ev} :¹⁵

$$\log (\lambda_i^{ev}) = \frac{1}{\sum_a \beta^a S_{us}(a)} \sum_a \beta^a [(S_i(a) - S_{us}(a)u_i + S_{us}(a)(u_i - u_{us}))] \quad (6)$$

Jones and Klenow (2016) also provide an additive decomposition of the amount that each dimension of living standards adds to total welfare relative to the United States. This decomposition varies slightly between the equivalent and compensating variation. In the case of the equivalent variation, we have:

$$\begin{aligned} \log \lambda_i^{ev} = & \sum_a \Delta s_i(a) u_i \\ & + \log c_i - \log c_{us} \end{aligned} \quad (7)$$

where $\Delta s_i(a) = \beta^a (S_i(a) - S_{us}(a)) / \sum_a \beta^a S_{us}(a)$. In the previous equation, the first term measures the contribution of differences in life expectancy to relative welfare levels and the second term captures the contribution of consumption. In the equivalent variation, the first term is multiplied by the utility flow in country i and in the compensating variation we use the United States. As a result, the equivalent variation gives relatively low weight to life expectancy for low-income countries since differences in this variable are weighted by relatively low utility flows. In the case of the compensating variation, life expectancy differences are weighted by the American utility flow which gives more weight to them. In this paper, I take the geometric average of the two.

3.2 Across-time comparisons

For comparisons of welfare over time, Equation 11 is also used. However, instead of comparing countries with the United States, now a country is compared with itself in different years. For example, if we want to know the extent to which people became better off in the United States during the period 1900-1950, then we use 1900 as benchmark for the compensating variation and 1950 for the compensating variation. As before, the equivalent variation weights life expectancy differences by utility flows in 1900 and the compensating variation by utility flows in 1950. Formally, welfare growth rates can be calculated as follows:

¹⁵For the compensating variation the formula is almost the same. Instead of using the survival rates of the United States in the denominator of the left term, we consider country i .

$$g_i \equiv -\frac{1}{t_1 - t_0} \log \lambda_i \quad (8)$$

where t_1 and t_0 are the ending and starting year of the time period and $\log \lambda_i$ is $\sqrt{\log \lambda_i^{ev} \cdot \log \lambda_i^{cv}}$.

To assess the extent to which traditional income measures (e.g. income per capita) might underestimate welfare growth over this period, Jones and Klenow (2016) provide a way of decomposing the ratio of the welfare measure to income per capita as follows:

$$\begin{aligned} \log \frac{\lambda_i^{ev}}{\bar{y}_i} = & \sum_a \Delta s_i(a) u_{it0} \\ & + \log c_{t0}/y_{t0} - \log c_{t1}/y_{t1} \end{aligned} \quad (9)$$

where \bar{y}_i is the ratio of income per capita in t_0 to t_1 in country i , and $\Delta s_i(a) = \beta^a (S_{t0}(a) - S_{t1}(a)) / \sum_a \beta^a S_{t1}(a)$. With this transformation, the consumption term does not refer to absolute consumption but to the share of consumption with respect to income per capita. In other words, welfare relative to income per capita is higher when the share of consumption in GDP is high.

4 Data and calibration

This section presents the data that will be used to calculate welfare across countries and time, and briefly analyses the development of living standards when looking at the dimensions of health and income separately during the first half of the 20th century in Western Europe. The sample consists of 13 countries: Spain, Portugal, Italy, France, Germany, Switzerland, the Netherlands, Belgium, the United Kingdom, Denmark, Sweden, Finland and the United States.

To compare well-being across countries and time, I chose six benchmark years. The first three are 1900, 1913 and 1920, which have been selected to provide estimates before and after WWI avoiding the troublesome period 1914-1918. And the three last benchmark years are 1929, 1938 and 1950 that are aimed at providing estimates before the Great Depression as well as before and after WWII avoiding war years. To avoid the effect of exceptional values of income and/or health on the welfare comparisons, I took five-year averages for 1900 and 1950 and three-year averages for the rest.¹⁶

¹⁶The averages were constructed as follows. For 1913 and 1920, I considered the periods 1911-1913 and

Income

To measure the income dimension, several indicators can be employed: wages, income per capita and household consumption. The use of wages has three main advantages. One is that they measure the income of a large part of the population, which makes them very representative. Also, potential biases introduced by dynamics in income inequality are fewer, since the distribution of wages in a sector or industry varies to a lesser extent than with other aggregate income measures. The third advantage is that for some countries it is possible to disaggregate by a large number of industries, which allows for estimates for different groups of the population. On the negative side, the availability of real wage data is very limited for the period 1900-1925 (Clio Infra). Another indicator is income per capita. Its main weakness is that it does not take into account the distribution of income among the population. Therefore, it becomes less representative of the overall income status of the population as income inequality increases. On the positive side, income per capita is a broad indicator of well-being and it is widely available for a large number of countries during the first half of the 20th century (Oulton, 2012). Finally, a less-used indicator in historical periods derived from income per capita is household consumption per capita that measures the share of national income that is actually consumed by households. This measure is particularly interesting for this time period due to the dynamics between government spending and GDP. Rising political tension between the two wars in some countries such as the United Kingdom resulted in increased military spending and therefore GDP per capita increases (Barro & Ursua, 2008) which did not directly benefit the population. A further advantage of this indicator is that data on household consumption is available for a large number of European countries. However, similar to income per capita its representativeness is affected by trends in consumption inequality.

Even though these indicators measure the same dimension of well-being, they measure different things. Therefore, we should not look for the best indicator, but rather for the one that better suits the aim of this paper, namely to provide a comprehensive analysis of Western European welfare for a large number of countries during the first half of the 20th century. For this purpose, I will use income and household consumption per capita. Whereas the latter will be the main input to measure the income dimension of well-being in the model,

1920-1922 to avoid the effect of WWI. For 1929 and 1938, I took 1927-1929 and 1936-1938 to have a benchmark before and during the Great Depression (in the Spanish case, I considered 1933-1935 since the civil war took place in the period 1936-1939). In a strict sense, these averages refer to the year in the middle of the periods considered (i.e. 1912, 1921, 1928 and 1937) and not to the ones I have referred to so far. However, since these benchmark years are widely used in the literature and such averages make my results more robust, in the remaining of this paper I will continue to use them, even though strictly speaking they refer to a year earlier or later.

data on the former will be provided to assess the underestimation of living standards by this measure.

Table 1: Income per capita during the first half of the 20th century

	Income level (US=100)						Average annual growth			
	1900	1913	1920	1929	1938	1950	1900-13	1920-29	1929-38	1900-50
United States	100	100	100	100	100	100	1.89	2.46	-0.71	2.61
Denmark	79	81	80	79	99	76	2.15	2.35	1.9	2.44
Finland	40	40	36	41	56	46	1.83	4.21	3.24	3.29
Sweden	52	55	57	61	80	72	2.37	3.39	2.55	4.36
Norway	66	66	69	69	96	82	1.91	2.29	3.53	3.80
Average NE	59	60	60	62	83	69	2.08	2.85	2.73	3.38
Belgium	97	88	83	82	86	62	1.04	2.4	-0.3	0.94
France	69	67	62	68	72	54	1.59	3.79	-0.08	1.61
Germany	74	72	60	64	80	42	1.66	3.47	1.88	0.60
Netherlands	90	84	89	93	93	67	1.17	3.07	-0.68	1.44
Switzerland	172	171	142	156	160	121	1.88	3.80	-0.47	1.25
UK	103	88	79	77	94	69	0.52	2.08	1.61	1.10
Average NWE	101	95	86	90	98	69	1.3	3.14	0.14	1.2
Italy	56	54	50	50	55	42	1.6	2.6	0.2	1.4
Spain	51	46	48	47	48	28	0.9	2.1	-0.4	0.5
Average SE	53	50	49	48	51	35	1.3	2.3	-0.1	1.0
Average WE	79	76	71	74	85	63	1.5	3.0	0.8	1.7

Note: data was taken from Bolt et al. (2015). For information on the construction of the benchmarks, see the beginning of this section and especially footnote 16. In the left panel, income levels are expressed relative to the United States in that same year.

To analyse the evolution of income per capita during the first half of the 20th century, I present in Table 1 income per capita levels (relative to the United States) for six benchmark years and calculate growth rates for four sub-periods.¹⁷ Over the period 1900-1950 the average growth of income per capita in Western Europe is 1.7 percent yearly (0.9 percent slower than in the United States). However, this figure hides some important variation across countries and time. For example, the growth rate of income per capita in the 1920s (2.9 percent) highly contrasts that of the earlier and later sub-periods (1.5 or 0.8 percent). The growth rates of the 1920s cannot be fully explained by post-WWI reconstruction since these remained even after reaching pre-war income levels (Roses & Wolf, 2010, 188). Also,

¹⁷See Roses and Wolf (2010) for a thorough account of aggregate growth in Europe with a larger sample during this period.

good-performing countries such as Sweden or Switzerland were not involved in the war and during these years their economies oriented towards higher value-added industries (Krantz, 1987; Siegenthaler, 1987). In the Finnish case, strong industrialization can explain its good performance (Hjerppe & Jalava, 2006). Furthermore, there is a large degree of heterogeneity across countries with several of them even presenting negative growth rates in the 1930s such as the United States or the Netherlands while others were growing as much as 3.5 percent such as Norway or Finland. In North-Western Europe, the German experience stands out with a yearly growth rate of 1.9 percent. However, this figure must be interpreted cautiously since it is not showing a significant increase in living standards, but rather a rearmament policy based on government debt and low nominal and real wages (Ritschl, 2002).

In terms of levels, North-Western Europe takes the lead during the whole period although by 1950 it presents the same income levels as in Northern Europe due to strong growth in this region in the 1930s. The relative decline of the 'core' (together with Southern Europe) has some implications for overall Western European performance with respect to the United States. Over this period, the average income level of a Western European relative to the United States dropped from 90.6 to 63.5 percent. Similarly to growth rates, generalisations are prone to be inaccurate since income levels within Western Europe could differ by a factor of four or five.

Do these trends correspond to those shown by household consumption per capita? To answer this question, I obtained information on this indicator from Barro and Ursua (2008). In this dataset, consumption indices are provided for a large number of countries. To obtain cross-country levels of consumption, I took consumption levels in constant 2011 international dollars from World Bank (2013) and extrapolated backwards using the aforementioned indices. By doing this, I put together yearly time series of household consumption per capita for the whole sample except for Belgium, for which data on consumption is only available from 1913 onwards. To have a balanced dataset, I have completed these 13 years by assuming that the growth rate of consumption from 1900 to 1912 was the same as for income per capita.

Table 2: Household consumption per capita during the first half of the 20th century

	Consumption level (US=100)						Average annual growth			
	1900	1913	1920	1929	1938	1950	1900-13	1920-29	1929-38	1900-50
United States	100	100	100	100	100	100	1.0	2.6	0.2	1.7
Denmark	73	85	103	92	107	86	2.4	1.2	1.9	2.3
Finland	32	35	35	37	42	39	1.9	3.8	1.6	2.5
Sweden	53	59	71	67	84	74	2.1	1.8	3.1	3.2
Norway	50	49	61	55	65	55	1.0	1.1	2.2	2.0
Average NE	52	57	67	63	74	64	1.9	1.7	2.2	2.5
Belgium	84	84	86	81	84	59	1.0	1.9	0.5	0.6
France	62	61	67	62	60	47	0.9	1.7	-0.3	0.8
Germany	63	61	50	58	58	39	0.8	4.8	0.2	0.3
Netherlands	68	71	74	69	71	60	1.5	1.8	0.4	1.2
Switzerland	133	125	135	134	141	115	0.5	2.5	0.7	1.2
UK	89	81	87	80	89	67	0.3	1.4	1.5	0.8
Average NWE	83	81	83	81	84	65	0.8	2.2	0.6	0.8
Italy	45	48	57	50	47	40	1.5	1.0	-0.6	1.2
Spain	52	47	57	57	55	32	0.3	2.7	-0.2	0.2
Average SE	48	47	57	54	51	36	0.9	1.8	-0.4	0.7
Average WE	67	67	73	70	75	59	1.1	2.0	0.9	1.3

Note: data was taken from Barro and Ursua (2008). For information on the construction of the benchmarks, see Table 1. In the left panel, income levels are expressed relative to the United States in that same year.

Table 2 shows household consumption per capita levels with respect to the United States (left panel) and growth rates for several periods (right panel). Overall, consumption per capita shows a similar trend as income per capita with larger growth rates in the 1920s than in the 1930s although somewhat slower than for income per capita. Considering the period 1900-1950, the extent to which GDP and consumption growth rates differ range from 0.09 to 1.75 yearly. The cases of the France and the United States for the whole period, or Germany during the 1930s are remarkable in that consumption figures cut growth in living standards by 1.7, 0.9 and 1.7 percent respectively. Within Western Europe, economies in the north of Europe keep performing above average in terms of consumption. With respect to the United States, Western European performance now looks more similar (although still 0.3 percent below the American growth rate). In terms of levels, consumption per capita exhibits lower figures across countries painting a somewhat more pessimistic picture. Also, North-Western and Southern Europe keep exhibiting a long-term relative decline (although less marked). Relative to the United States, in terms of consumption Western Europe dropped from 67 to

59 percent.

What do these developments imply for the story of living standards during the first half of the 20th century in Western Europe? Especially some countries in North-Western and Southern Europe saw their living standards increase by rates (on average) below one percent, whereas Northern Europe managed to keep relatively high growth rates over the whole period. Within Europe, this meant income convergence in Northern and North-Western Europe, and further lagging behind in the south of Europe. With respect to the United States, Western Europe failed to converge due to lower economic performance in the south and the north-west of Europe.

The reasons for the sluggish and heterogeneous growth experiences are manifold given the international challenges of the period. Firstly, the extent to which countries were affected by armed and social conflicts determined their ability to use their productive capacity (Svennilson, 1954; Ritschl & Straumann, 2010). Secondly, increasing political tensions ended up in protectionism and migration restrictions which in turn prevented an efficient allocation of resources (Findlay & O'Rourke, 2003). And thirdly, economic nationalism and inward-looking policies resulted in uncoordinated macroeconomic policies as illustrated by the failure of the re-establishment of the gold standard (Eichengreen, 1992).¹⁸ These events were far-reaching in that they influenced the political, economic and social sphere worldwide. In the next section, I will show whether the developments shown by the income were paralleled by health.

Health

To account for the health dimension of living standards in the model I will use data on age-specific survival rates. These data is derived from country-level life tables and measure the probability of an individual of reaching a certain age. For most of the countries, the main source is the Human Mortality Database (HMD) which provides yearly life tables with the exception of Spain, Germany, the United States and the United Kingdom, for which the series only start in 1908, 1956, 1933 and 1922 respectively. For the United Kingdom, data prior to 1923 refers to England and Wales.¹⁹ For the United States and Germany, I used the Human Life-Table Database (HLTD) to fill the gaps. In the German case, I had to use two life tables derived from age-specific mortality rates for the periods 1891-1900 and 1901-1910 to obtain an average survival-rate estimate for 1900. And for Spain, I draw on Goerlich (2008) to get data for 1900.

¹⁸See Ritschl and Straumann (2010) and Roses and Wolf (2010) for a more extended elaboration on this topic.

¹⁹Note that despite the series for the United Kingdom in the HMD starts in 1922, I use data for England and Wales in this year to obtain a consistent average for 1920.

How did the health status of the population evolve during the first half of the 20th century? To answer this question, Table 3 presents data on life expectancy. Even though this measure is less comprehensive than age-specific survival rates, it is more intuitive and clear for a descriptive purpose because it measures the expected life time at a certain age in a given year given the present mortality rates in subsequent ages.

Table 3: Life expectancy at birth and at the age of five in Western Europe and the US

	Life expectancy at birth						Life expectancy at five					
	1900	1913	1920	1929	1938	1950	1900	1913	1920	1929	1938	1950
United States	49	54	57	59	61	68	55	57	59	59	61	66
Denmark	53	58	60	62	64	70	58	61	62	63	64	68
Finland	45	49	51	52	57	64	53	54	55	55	58	62
Sweden	53	58	60	62	65	71	57	60	61	62	64	68
Norway	54	58	60	63	66	72	57	59	60	62	65	69
Average NE	51	56	58	60	63	69	56	58	59	61	63	67
Belgium	48	51	54	57	60	66	56	58	59	60	62	65
France	46	50	53	55	59	66	54	56	57	58	60	65
Germany	44	49	n.d.	n.d.	n.d.	67	55	57	n.d.	n.d.	n.d.	66
Netherlands	49	56	59	63	67	71	58	61	62	63	66	69
Switzerland	49	53	57	60	63	68	55	57	58	60	62	66
UK	47	53	57	59	62	69	55	59	60	61	63	66
Average NWE	47	53	57	59	62	69	55	59	60	61	63	66
Italy	43	47	48	52	56	65	54	57	57	59	61	66
Spain	35	42	42	49	52	62	49	53	53	56	58	64
Average SE	39	45	45	51	54	63	52	55	55	58	59	65
Average WE	47	52	55	58	61	68	55	58	59	60	62	66

Note: see the text for the sources. For information on the construction of the benchmarks, see Table 1.

To provide different perspectives, Table 3 presents data on life expectancy at birth (left panel) and at the age of five (right panel). If we first consider life expectancy at birth, two points are worth highlighting. The first is that life expectancy at birth in Western Europe and the United States roughly increased by 19 years over the period 1900-1950. In other words, an average newborn individual in Western Europe or the United States was expected to live 19 years longer in 1950 than in 1900. Most of the progress in both regions was achieved in the periods 1900-1913 and paradoxically 1938-1950 with five- and seven-year increases respectively). Zooming in within Western Europe, we can observe large variation across geographic regions (as for income) being Southern Europe the fastest-growing area followed

by North-Western Europe. But also within geographic regions experiences can differ as well. Consider the Dutch-French case. Life expectancy experiences a rapid increase in the Netherlands up to 1938 whereas France is not able to keep up with this pace. In Southern Europe, Spain presents faster growth rates than Italy.

In terms of levels, Northern Europe leads the way during the whole period followed closely by North-Western Europe. As for growth rates, there is a large degree of heterogeneity over the whole period (although it diminishes over time). Whereas in 1900 the difference between the best- and worst-performing country in terms of life expectancy at birth amounted 18 years, in 1950 this figure decreased to ten years. Contrary to the picture portrayed by life expectancy growth rates, the geographic region that performed best was Northern Europe followed by North-Western Europe which indicates that higher growth rates in Southern Europe might have been due to lower starting levels. However, such a generalisation across regions might be oversimplifying because we can observe important differences within regions. Taking Northern Europe as an example, we see that whereas Sweden is the undisputed leader from 1900 to 1913, Finnish life expectancy levels resemble those in Italy. The same is true for France and the Netherlands as Dutch levels are closer to those in Northern Europe (even surpassing them in the 1920s), while French levels are closer to American and Finnish levels. Finally, if we compare Western Europe with the United States, we see that Western Europeans had a lower life expectancy until 1938. By considering individual countries though, some exhibit higher levels than the Americans such as Sweden, Norway or the Netherlands.

Without discussing yet the specific factors that might have caused such improvements in health, we first should be aware of the effect changes in mortality at the youngest ages have on this measure. During the first half of the 20th century, infant and child mortality declined enormously as a result of progress against the contagion of airborne diseases like influenza or pneumonia for children less than five, and water-borne diseases such as gastroenteritis for infants (Millward & Baten, 2010). To provide an illustration of the magnitude of the mortality decrease, consider the British case. Whereas at the beginning of the period 22 percent of a cohort of 100,000 people would die before reaching the age of 5 given the current mortality rates, in 1950 this figure declined to only three percent. Thus, the impression of health improvements will be very different if we consider the perspective of a newborn or the one of a child that has reached the age of 5. To see whether this makes a difference in trends and levels, we can look at life expectancy figures at the age of 5 in the right-hand side of Table 3.

As expected, considering the life expectancy of an individual at the age of five reduces the years gained and cross-country differences over the period substantially, namely by roughly a half. Whereas the increase in Western European life expectancy with the 'newborn' ap-

proach for the period 1900-1950 was 19 years, now this figure is 11 years. However, despite this reduction, the main points discussed earlier concerning high levels of heterogeneity and trends across countries and regions still hold with two exceptions. One is that cross-country experiences look more homogeneous than before and the other is that Western Europe is now at the same level of the United States during the whole period (and even slightly ahead in some years such as 1929 or 1938). Overall, despite health improvements might look somewhat less impressive, an average 5-year-old Western European in 1950 was expected to live 11 years longer than in 1900. As with life expectancy at birth, this is still an unparalleled achievement if we look at earlier and subsequent time periods.

At this point, a question arises whether in the remaining of the paper we should consider one measure or the other since the differences are indeed sizeable. Put another way, should we take the perspective of a newborn or a five-year old child for assessing health improvements over this period? In this study I will not tackle this question but adopt the idea that both perspectives are desirable and choosing one of the other (or maybe a third one) depends on the particular health aspect of the population that one wants to analyse. For comparisons, I will use both perspectives for the welfare calculations.

What are the causes of these health improvements?²⁰ The literature on this topic has pointed at two main factors. The first is reduced exposure to illnesses due to improvements in water supply and sewerage systems (Cutler & Miller, 2005; Ferrie & Troesken, 2008; Cutler et al., 2006), change in households' habits induced by the development and spread of the germ theory of disease and the creation of childcare centres where mothers could get counselling (Mokyr & Stein, 1997), improved living and working conditions, and the fertility decline that helped raise the health status of mothers (Millward & Baten, 2010). The second factor concerns the increased resistance of the human body to disease as a consequence of the improving health of mothers (Millward & Baten, 2010), public health care provision (Winegarden & Murray, 1998) and improved nutrition through higher wages (Fogel, 2004). Despite there is a broad agreement on the influence of these factors on health developments over the period 1900-1950, the literature has not reached a consensus yet with regards their relative importance. For this reason, in this study I will refrain from explaining cross-country health (and later welfare) differences but rather I will account for them as a result of the interplay of the aforementioned factors.

How do developments in health complement or contradict trends in income? Firstly, the evolution of living standards as measured with life expectancy reveals a historically unprecedented improvement contrary to the evolution of the income dimension that has

²⁰The number of studies in this topic is unsurprisingly large. See Millward and Baten (2010), Costa (2015), Cutler et al. (2006) or Leonard and Ljungberg (2010) for a more comprehensive review.

been termed as being 'unusually' low (Roses & Wolf, 2010). The pace of this improvement is at odds with that of consumption or consumption per capita since life expectancy experiences the largest increases in the 1910s and 1930s while consumption experiences the largest increase in the 1920s. Secondly, high income countries such as Switzerland or Belgium do not exhibit high life expectancy levels (especially at the beginning of the period). Because of this, the relative decline of North-Western and Southern Europe in terms of consumption is not paralleled by a similar development in terms of health, rather the opposite. With respect to the United States, Western Europe is at the same level and shows no gap in living standards. To make sense of these disparate developments, we need a composite view which will be provided by the new welfare measure in the next section.

Calibrating the model

The last input to the model is \bar{u} . Here, I follow Jones and Klenow (2016) and consider that a 40-year old person in the United States has a statistical value of remaining life of \$6 millions in 2006. To adjust this figure for earlier welfare comparisons, I obtained a 1950-equivalent figure by applying a unitary income elasticity of the VSL (value of a statistical life). This implies that the VSL increases or decreases proportionally to income. Finally, a value for \bar{u} was obtained by using American aggregate income per capita in 1950, and a discount rate and consumption growth rate over the life cycle of two percent. The value for \bar{u} is then 5.13.

5 Results

Across time comparisons

As discussed in the data section, the extent to which health improved over this period depends on the perspective that we adopt. If we take the perspective of a newborn, we will observe large increases in the probability of surviving across all ages due to the impressive reduction of child mortality over this period. If we take the perspective of a five-year-old child though, we would ignore these changes and would focus exclusively on health improvements above the age of five. In this paper, I present welfare estimates based on both views for comparisons. However, I rather focus on the 'newborn' approach since ignoring the idea that by 1950 virtually all individuals in a given cohort could survive until the age of five would miss a very important part of the story of living standards.²¹

²¹For estimating welfare across countries and time taking the 'five-year-old' view, I considered the counterfactual that mortality rates below the age of five were the same across countries and time.

Table 4: Annual well-being growth rates for the period 1900-1950

Countries	Welfare (I)	GDP per capita (II)	Difference (III)	LE (IV)	C (V)
USA	4.4	1.7	2.7	3.2	-0.5
Denmark	4.4	1.6	2.8	2.8	-0.1
Finland	5.1	1.9	3.2	3.5	-0.3
Sweden	4.7	2.3	2.4	2.8	-0.4
Norway	4.2	2.1	2.1	2.8	-0.7
Average NE	4.6	2.0	2.6	3.0	-0.4
Belgium	3.8	0.8	3.0	3.3	-0.3
France	4.3	1.2	3.1	3.6	-0.5
Germany	4.4	0.5	3.9	4.2	-0.2
Netherlands	4.7	1.1	3.6	3.7	-0.1
Switzerland	4.3	1.0	3.3	3.4	-0.1
UK	4.4	0.9	3.5	3.8	-0.2
Average NWE	4.3	0.9	3.4	3.7	-0.2
Italy	5.1	1.1	4.1	4.2	-0.1
Spain	6.4	0.5	5.9	6.2	-0.3
Average SE	5.8	0.8	5.0	5.2	-0.2
Average W. Europe	4.7	1.2	3.4	3.7	-0.3

Note: see Table 1, 2 and the health sub-section for the sources. For information on the construction of the benchmarks, see Table 1. The growth rates were calculated using Equation 7 and 8.

Table 4 depicts the overall development of living standards over the period 1900-1950 for 12 European countries and the United States (see Table 1 in the Appendix for the calculations taking the 'five-year-old' view). The first two columns present figures on the annual percentage growth rate of living standards measured with the new welfare measure and with income per capita. Column III shows the difference between these two indicators. And the last two columns show whether the differences in welfare and income per capita growth rates come from differences in life expectancy (Column IV) or household consumption share of national income (Column V). To interpret the results in this table, consider the example of Belgium. Measured with the new welfare indicator, Belgian well-being increased at a rate of 3.8 annually over the period 1900-1950, whereas income per capita grew by 0.8 percent.²²

²²Note that this growth rate is slightly different from the one shown in Table 1. This is because the decomposition in Equation 7 is made in logarithmic terms and these are just an approximation to percentage changes. Except for Northern European countries and the United States, growth rates calculated in this

Why are these growth rates so different? The main factor explaining this is the positive contribution of life expectancy to welfare growth, i.e. three percent annually. The difference between welfare and income growth could have been larger if the share of household consumption share in 1950 had not been lower than in 1900, because it reduced Belgian welfare growth by 0.3 percent annually.

As a general point for all countries, Table 4 shows that welfare growth rates are always corrected upwards. This is mainly due to the positive contribution of health improvements to well-being, which ranges from 2.8 (in Denmark and Sweden) to 6.2 percent (in Spain). The consumption share of GDP (and not absolute consumption) contributes typically negatively and it ranges from 0.1 (in the Netherlands, United Kingdom or Italy) to 0.7 percent (in Norway). It should be noted that differences in consumption might come from differing public expenditure figures in that some countries might have relied more on government spending to provide essential public services such as education and health. Also, lower private consumption shares can be explained by high investment rates. If this is the case, then welfare growth at present can be low but its future potential increases as new investments increase the productive capacity of the economy. In any case, the positive contribution of health largely compensates for this negative short-term effect.

To what extent is welfare growth being underestimated by income per capita? Taking Western Europe as a whole, the welfare measure suggests that GDP per capita is underestimating growth in well-being by 3.4 percent yearly. In other words, the new measure suggests a welfare improvement almost three times larger than income per capita. Another way to look at these figures is by considering an average European in 1900 that would survive over the whole period and asking the question: how many years would this individual need to double his current level of living standards? Without accounting for health, this individual would see its living standards doubling roughly every 60 years, whereas accounting for health well-being would double every 15 years (an almost fourfold increase over the period). If we consider the perspective of a five-year-old child instead, the underestimation of living standards is lower (1.4 percent) because the improvement in survival rates do not take into account progress before on this before the age of five (see Table 1 in the Appendix). As a result, well-being would double every 27 years.

Within Western Europe, the region for which income per capita underestimates welfare the most according to the welfare measure is Southern Europe. Despite the very low performance in economic terms (0.8 percent annually), the impressive health improvements correct this figure by five percent yearly. Because of this, this region exhibits the largest growth rates in well-being as opposed to the picture shown by income or consumption per capita.

manner are very close to those in Table 1.

Moreover, the welfare measure is also at odds with the development of the income dimension between Northern and North-Western Europe. Whereas in terms of GDP per capita living standards were growing significantly faster in the north of Europe, the welfare measure indicates that growth in well-being was only 0.3 percent slower. The reason is that health improvements are contributing to welfare to a larger extent in North-Western Europe.

Although the general picture is similar for all countries, we see interesting developments among which two are worth mentioning. First, the link between welfare and income per capita is not straightforward. In some cases, high income per capita growth does not result in above-average welfare growth such as in Sweden, Denmark or the United States. Similarly, low income growth does not necessarily translate into low welfare performance as illustrated by the case of Spain. However, the opposite is true if we adopt the view of a five-year-old child. High-performing countries in terms of income per capita typically perform better in terms of welfare in all sub-periods (see Figures 1 and 2 in the Appendix). This suggests that the relationship between income and the welfare measure gets stronger as we focus on segments of the population older than five. What explains this changing relationship? To answer this question, we must look at the causes of health improvements below and above the age of five. For example, if health developments were independent of those for income below the age of five, then we would expect the welfare measure move independently depending on the size of those health improvements. This is in line with Preston (1975) who argues that factors exogenous to the level of income had a major impact on mortality trends during this period. However, if health improvements above the age of five are strongly dependent on income, then the welfare measure would correlate with income per capita. This other argument is supported by Fogel (1994) who claims that improved nutrition derived from higher income levels drove the mortality decline.

Did welfare follow the same dynamics over time as income per capita? To answer this question Table 2 in the Appendix provides welfare growth rates for different periods. As we saw in the previous section, income per capita growth in Western Europe was modest up till 1913, then it peaked in the 1920s and slowed down in the 1930s to the point that some countries such as the Belgium or the Netherlands exhibited negative growth rates. By accounting for health, the dynamics look rather different. In terms of welfare, the most prosperous period are the pre-WWI years instead of the 1920s and, most interestingly, the period of the Great Depression seem to have been a period for living standards almost as good as the 'golden twenties' after accounting for the rising health status of the population.

Cross-sectional comparisons

To understand the implications that different growth rates had in the relative position of Western European countries and the United States, I present estimates of welfare levels with respect to the United States in Table 5 (a further table, Table 3 and 4, is shown in the Appendix to provide a decomposition of the forces driving the welfare differences in 1900 and 1950). The picture is significantly different as the one suggested by income per capita. Firstly, North-Western Europe is not leading Europe any more in favour of the northern economies. The reason for this is that both survival rates and the share of consumption in GDP are better in the north of Europe (see Table 3 in the Appendix). Secondly, despite the north-western part of Europe keeps exhibiting a long term decline over the period (interrupted in the 1930s), Southern Europe shows sign of strong convergence in the 1920s and 1930s similar to Northern Europe. However, its relative position with respect to the United States is still very low since welfare for an average Spaniard in 1950 was 21 percent of an American citizen. This is explained by the very low health levels in this region despite rapid improvements. And thirdly, if we look at Western Europe as a whole, we observe that welfare levels did not deteriorate in the long-run as indicated by income per capita. As a result, the welfare difference between a typical Western European and an American was roughly the same throughout this period, namely almost two thirds of the American level.

An important point to notice in the previous table is that the welfare measure shows a very similar well-being level as income per capita for Western Europe, specially in 1950 (63 and 62 percent of the US level respectively). While this might in principle provide support the use of income per capita to assess cross-country well-being, this support vanishes as one looks at individual countries. The welfare measure adjusts income per capita downwards or upwards indistinctly. For example, if we look at Denmark and Germany in 1900, these countries have income levels of 79 and 74 percent of the US level. In terms of welfare, these figures are 102 and 38 percent respectively. Another similar case is illustrated by Switzerland and France with income levels of 160 and 72 percent of the American level in 1938, and welfare levels of 96 and 50 percent respectively. To look at this issue in a more comprehensive way, we can look at Figure 3 in the Appendix which plots relative welfare and income per capita levels for the sample and the six benchmarks. If the observations lie on the 45-degree line, this would mean that the welfare measure would be capturing the same as income per capita and therefore it would not be of much use. However, we can observe exactly the opposite. Since observations lie above and below the 45-degree line, this means that the welfare measure is correcting income per capita both upwards and downwards. Therefore, the similar levels that the welfare measure and income per capita might show for some regions is the net effect of the deviations from the 45-degree line, and not similar cross-country values in both measures.

Table 5: Welfare levels relative to the United States during the period 1900-1950

	1900	1913	1920	1929	1938	1950
USA	100	100	100	100	100	100
Denmark	102	124	129	117	135	103
Finland	21	23	20	22	30	30
Sweden	76	86	92	87	113	94
Norway	78	71	79	76	95	72
Average NE	69	76	80	76	93	75
Belgium	74	67	67	67	76	53
France	46	45	46	46	50	41
Germany	38	39	n.d.	n.d.	n.d.	36
Netherlands	68	87	87	96	111	76
Switzerland	129	122	132	152	170	120
UK	73	78	89	80	96	70
Average WE	71	73	70	74	84	66
Italy	23	26	25	29	31	32
Spain	9	14	12	23	31	21
Average SE	16	20	19	26	31	27
Average W. Europe	61	65	65	66	78	62
Std. Dev. WE	0.73	0.66	0.75	0.63	0.61	0.53

Note: see Table 1, 2 and the health sub-section for the sources. For information on the construction of the benchmarks, see Table 1. The welfare gaps were calculated using Equation 7. The standard deviation for Western Europe was calculated by considering the log-transformed welfare levels of all countries except for the United States.

With the growth rate and level analyses, we can now test some hypotheses related to welfare convergence over this period. In terms of GDP per capita, Roses and Wolf (2010) only finds conditional beta convergence in Europe during the period 1922-1938 (i.e. conditional on human capital differences and investment conditions European countries GDP per capita converged). Drawing on this literature, in terms of welfare we can look at sigma convergence (i.e. reduction in welfare dispersion across countries) and unconditional beta convergence (i.e. correlation between initial welfare level and growth over time).

By looking at Western Europe, I find that the standard deviation of welfare decreased in 1950 compared with 1900 by 0.2 log points. However, this is mainly driven by Spain, Italy and Finland. If one considers other benchmarks, we can observe a rising standard deviation up to 1920 and then a steady decrease indicating welfare convergence (see Table 5). Was there

unconditional beta convergence? Figure 4 in the Appendix offers some support, however the apparent negative correlation between levels of welfare in 1900 and growth rates during the period 1900-1950 are mainly driven by the observations of Spain, Finland and Italy. If we consider the welfare growth rates taking the 'five-year-old' perspective instead, we observe no signs of convergence (see Figure 5 in the Appendix). To sum up, despite the low number of observations, we can conclude that there are weak signs of welfare convergence.

6 Robustness Tests

In the following, I will show that the conclusions in the previous section are robust to a number of changes in the model and the data. The first test concerns the choice of the initial benchmark for computing welfare and income growth rates during the first half of the 20th century. Typically, studies in this literature choose the years 1913 and 1950 (Prados de la Escosura, 2015; Crafts, 1997, 2002). To check whether a change in the initial year changes my conclusions, Table 6 shows welfare growth rates for the periods 1900-1950 and 1913-1950.

As Column I and II in Table 6 show, choosing a different benchmark year for analysing the evolution of welfare during the first half of the 20th century has a negligible impact on the welfare figures, namely a 0.2 percent lower increase in well-being in Western Europe. This lower figure is almost entirely driven by the revised rates for Southern Europe (more specifically Spain, for which annual welfare growth drops from 6.4 to 5.7 percent). This significant revision comes from not including the substantial progress on mortality below the age of five in the first decade of the 20th century (Goerlich, 2008).

The second test concerns the data used for measuring the income dimension, namely household consumption per capita. This measure ignores government spending and might significantly influence relative welfare levels if the government plays a large role in some countries. To check for this, the left panel in Table 6 presents relative well-being levels using only household consumption as well as household and government consumption from Feenstra, Inklaar, and Timmer (2015). As Column III and IV show, including or excluding government spending has almost no impact on the overall results. The only two cases in which relative welfare levels are revised more than six percent are Switzerland and United Kingdom. Whereas in the former case welfare is reduced by nine percentage points, in the latter case welfare is revised upwards by six percent. What about the years prior to 1950? For the years 1900, 1910, 1920 and 1930, Lindert (1994, 10) presents figures on social transfers on unemployment, pensions, health and housing as a share of GDP for a large number of countries and these are never larger than five percent of total GDP. These data together with the welfare estimations for 1950 using information government consumption seem to

suggest that the results of the previous section will not significantly change if one considers government spending.

Table 6: Changing the initial benchmark year and including government spending

Countries	Initial benchmark change		Including G in 1950	
	1900-1950 (I)	1913-1950 (II)	Only C (III)	C + G (IV)
USA	4.4	4.4	100	100
Denmark	4.4	3.9	75	75
Finland	5.1	5.2	30	31
Sweden	4.7	4.6	84	87
Norway	4.2	4.4	73	75
Average NE	4.6	4.5	66	67
Belgium	3.8	3.9	53	53
France	4.3	4.3	42	43
Germany	4.4	4.3	25	27
Netherlands	4.7	4.1	54	59
Switzerland	4.3	4.4	99	90
UK	4.4	4.2	62	68
Average WE	4.3	4.2	56	57
Italy	5.1	5.1	25	27
Spain	6.4	5.7	21	19
Average SE	5.8	5.4	23	23
Average W. Europe	4.7	4.5	54	55

Note: see Table 1, 2 and the health sub-section for the sources. For information on the construction of the benchmarks, see Table 1. The growth rates were calculated using Equation 7 and 8. In column III and IV, 1950 refers to the average for the period 1950-1952.

A third test is to check the extent to which welfare growth rates and levels differ when considering a different VSL. For this purpose, I cut the value chosen for the baseline estimate by a significant one third. The left and mid panel in Table 7 present average welfare levels and growth rates of individual countries with a model specification that reduces the contribution of health by one third. For the welfare level calculations, I take the average of the six benchmark years considered in Columns I and II considering VSLs of six (my baseline estimate) and four million dollars (in 2006). Typically, those countries with low health status (e.g. Finland, Spain, Italy or Germany) are slightly revised upwards as a consequence

of valuing improvements in health to a lower extent. On the other hand, countries with high levels of health such as Denmark, Sweden or the Netherlands are revised downwards since their advantage in this dimension contributes less with a lower VSL. Overall, the results do not change since Western Europe exhibits a similar welfare level with respect to the United States and the high-welfare regions are still Northern and North-Western Europe with similar levels. In terms of growth rates, Column III and IV show that welfare growth rates are reduced by 1.4 percent during the period 1900-1950 if we consider a VSL of four million dollars. With this growth rate, the welfare measure suggests that living standards doubled every 22 years (instead of 15 years in the baseline calculations). But despite this significant growth rate reduction, the conclusions that living standards rose substantially faster than income per capita in the whole of Western Europe and the United States, Southern Europe is the fastest growing region followed by Northern Europe still hold.

Finally, I performed a fourth test to check that the alternative welfare figures provided by considering only improvements after the age of five (see Table 4 in the Appendix) are robust to further changes. For this purpose, I re-estimated welfare growth rates by assuming that survival rates between the ages of zero and nine are identical across time.²³ Columns V and VI in Table 7 show that we can safely use the 'five-year-old' perspective as a lower bound estimate for considering health improvements over this period. The two columns show very similar growth rates that in any case differ by more than 0.4 percent annually.

²³I also performed this exercise in terms of levels and these are very similar in both specifications.

Table 7: Changing the VSL and considering health improvements above the age of 10

	Change in the VSL				Age threshold	
	Welfare level (US=100)		Welfare growth 1900-50		Welfare growth 1900-50	
Countries	(\$6 mill.) (I)	(\$4 mill.) (II)	(\$6 mill.) (III)	(\$4 mill.) (IV)	Above 5 (V)	Above 10 (VI)
USA	100	100	4.4	3.2	2.8	2.6
Denmark	119	108	4.4	3.3	2.9	2.8
Finland	24	28	5.1	3.8	3.0	2.6
Sweden	91	82	4.7	3.6	3.4	3.2
Norway	79	69	4.2	3.1	3.1	3.0
Average NE	78	72	4.6	3.5	3.1	2.9
Belgium	67	71	3.8	2.6	1.9	1.7
France	46	50	4.3	3.0	2.4	2.2
Germany	38	43	4.4	3.0	1.9	1.8
Netherlands	87	80	4.7	3.3	2.5	2.4
Switzerland	138	135	4.3	3.0	2.6	2.5
UK	81	81	4.4	3.1	2.3	2.1
Average NWE	76	77	4.3	3.0	2.3	2.1
Italy	28	34	5.1	3.6	2.7	2.4
Spain	18	26	6.4	4.2	2.6	2.2
Average SE	23	30	5.8	3.9	2.6	2.3
Average W. Europe	68	67	4.7	3.3	2.6	2.4

Note: see Table 1, 2 and the health sub-section for the sources. For information on the construction of the benchmarks, see Table 1. Column I and II present the average welfare level of each individual country with respect to the United States for six benchmark years: 1900, 1913, 1920, 1929, 1938 and 1950.

7 Conclusions

To which extent did Europeans become better off over the first half of the twentieth century? Did welfare converge within Western Europe? How does Western Europe compare with the United States? In this paper, I have attempted to answer these questions by developing a new welfare indicator drawing on the methodology by Jones and Klenow (2016) which combines household consumption and age-specific survival rates. The main results suggest that income per capita has important flaws for assessing cross-country and over-time welfare over this period. The picture portrayed by income levels and growth rates look significantly

different if one considers the welfare applied in this paper.

In terms of growth rates, income's underestimation in living standards ranges from 2.8 to 6.2 percent in Sweden and Spain respectively. For Western Europe as a whole, yearly welfare grew by 4.7 percent in contrast with an income per capita growth of 1.2 percent, almost four times faster. Whereas income per capita suggests a doubling of the average welfare level every 60 years, the new welfare measure points to a doubling every 15 years (almost a fourfold increase over this period). A more conservative estimate drawing on health improvements above the age of five suggests doubling living standards every 27 years. Across time, the dynamics of welfare differ with income in that average income levels increased most rapidly in the 1920s and declined in the 1930s, while welfare peaked in the 1910s and kept growing throughout the Great Depression. Within Western Europe, the fastest-growing region in terms of welfare is not North-Western Europe but Southern Europe, and welfare growth rates between the north and northwestern parts of Europe look much more alike in terms of welfare.

In terms of levels, North-Western Europe loses the lead in favour of Northern Europe due to lower levels of health and consumption share over GDP and Southern Europe shows sign of strong convergence in the 1920s and 1930s. If we look at Western Europe as a whole, we observe that welfare levels did not deteriorate in the long-run as indicated by income per capita. As a result, the welfare difference between a typical Western European and an American was roughly the same throughout this period, namely almost two thirds of the American level. And thirdly, I find weak evidence of welfare convergence over this period largely driven by three countries.

In sum, despite low economic performance partly due to two world wars and the Great Depression, well-being improved significantly in many aspects over the first half of the 20th century (if one was able to escape the many armed conflicts, ethnic cleansings and population displacements that certainly had a large impact on short-term welfare). In this paper, I have focused on the health aspect and found that not taking into account other dimensions of living standards than income results in a serious underestimation of welfare growth and it misses an important part of the story of Western living standards in the 20th century.

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8 Appendix

Methodological extension

As presented in the methodological section, the expected lifetime utility for an individual in a certain country was given by:

$$U_i = \left[\sum_{a=1}^{110} \beta^a S_i(a) \right] \cdot (\bar{u} + \log c_i) \quad (10)$$

choosing a value of one for β to rewrite survival rates as $e \equiv \sum_{a=1}^{110} S(a)$, which equals life expectancy at birth, the previous equation can be simplified as follows:

$$U_i = e_i(\bar{u} + \log c_i) \quad (11)$$

where e_i is life expectancy at birth in country i . This equation represents the workhorse to compute utility flows across countries (and time) with respect to the United States as in equation 3.

Jones and Klenow (2016) also provide an additive decomposition of the amount that each dimension of living standards adds to total welfare relative to the United States. This decomposition varies slightly between the equivalent and compensating variation. In the case of the equivalent variation, we have:

$$\begin{aligned} \log \lambda_i^{ev} &= \frac{e_i - e_{us}}{e_{us}} (\bar{u} + \log c_i) \\ &\quad + \log c_i - \log c_{us} \end{aligned} \quad (12)$$

And in the case of the compensating variation we have:

$$\begin{aligned} \log \lambda_i^{cv} &= \frac{e_i - e_{us}}{e_i} (\bar{u} + \log c_{us}) \\ &\quad + \log c_i - \log c_{us} \end{aligned} \quad (13)$$

With this simpler framework, we can calculate welfare across countries and time by using life expectancy figures and apply it to earlier periods for typically age-specific survival rates are not available.

Table 1: Annual well-being growth rates for the period 1900-1950 taking the 'five-year-old' perspective

Countries	Welfare (I)	GDP per capita (II)	Difference (III)	LE (IV)	C (V)
USA	2.8	1.7	1.1	1.6	-0.5
Denmark	2.9	1.6	1.3	1.4	-0.1
Finland	3.0	1.9	1.1	1.4	-0.3
Sweden	3.4	2.3	1.1	1.5	-0.4
Norway	3.1	2.1	1.0	1.7	-0.7
Average NE	3.1	2.0	1.1	1.5	-0.4
Belgium	1.9	0.8	1.1	1.4	-0.3
France	2.4	1.2	1.2	1.8	-0.5
Germany	1.9	0.5	1.4	1.6	-0.2
Netherlands 2.5	1.1	1.4	1.6	-0.1	-0.1
Switzerland	2.6	1.0	1.7	1.7	-0.1
UK	2.3	0.9	1.4	1.6	-0.2
Average WE	2.3	0.9	1.4	1.6	-0.2
Italy	2.7	1.1	1.6	1.7	-0.1
Spain	2.6	0.5	2.1	2.3	-0.3
Average SE	2.6	0.8	1.8	2.0	-0.2
Average W. Europe	2.6	1.2	1.4	1.6	-0.3

Figure 1: Welfare and income per capita growth rates with the 'newborn' perspective

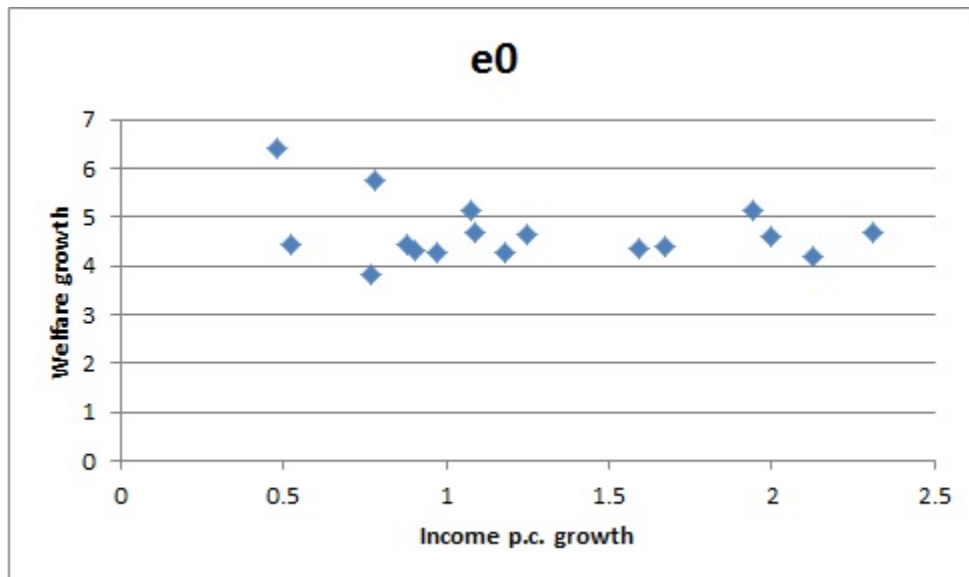


Figure 2: Welfare and income per capita growth rates with the 'five-year-old' perspective

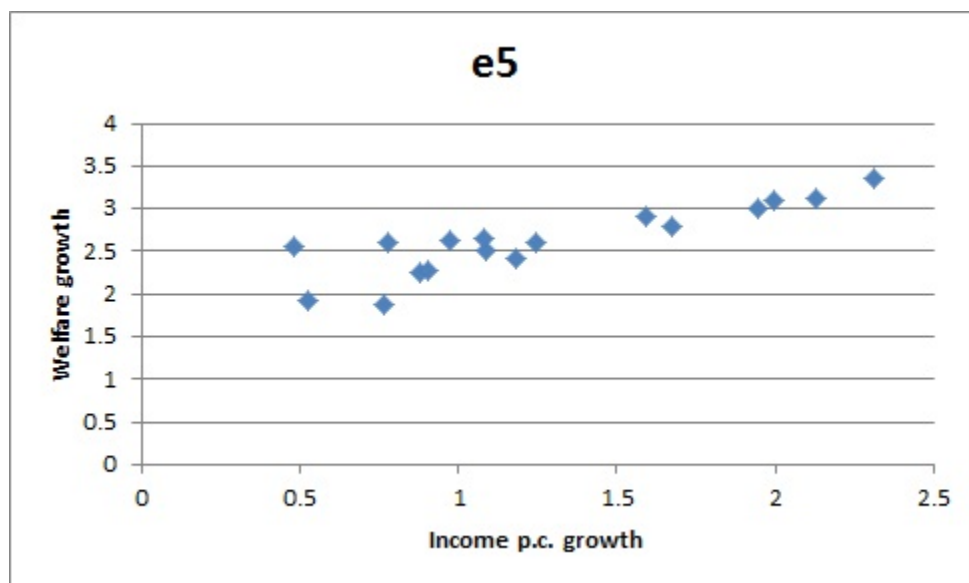


Table 2: Annual well-being growth rates for selected sub-periods

	1900-1913	1920-1929	1929-1938	1900-1950
USA	4.4	3.8	2.5	4.4
Denmark	5.8	2.7	4.0	4.4
Finland	5.3	5.0	6.2	5.1
Sweden	5.3	3.3	5.2	4.7
Norway	3.7	3.3	4.9	4.2
Average NE	5.0	3.6	5.1	4.6
Belgium	3.6	3.9	3.8	3.8
France	4.2	3.7	3.6	4.3
Germany	4.6	n.d.	n.d.	4.4
Netherlands	6.3	5.1	4.1	4.7
Switzerland	3.9	5.4	3.7	4.3
UK	5.0	2.7	4.5	4.4
Average WE	4.6	3.5	3.3	4.3
Italy	5.2	5.7	3.2	5.1
Spain	7.6	11.1	5.2	6.4
Average SE	6.4	8.4	4.2	5.8
Average W. Europe	5.0	4.3	4.0	4.7

Table 3: Living standards in 1900 taking the 'five-year-old' view

Countries	Welfare (I)	GDP per capita (II)	Difference (III)	LE (IV)	C (V)
USA	100	100	0	0	0
Denmark	102	79	0.2	0.3	-0.1
Finland	21	40	-0.7	-0.5	-0.2
Sweden	76	53	0.4	0.4	0
Norway	78	66	0.2	0.4	-0.3
Average NE	69	59	0.0	0.2	-0.1
Belgium	74	97	-0.3	-0.1	-0.1
France	46	70	-0.4	-0.3	-0.1
Germany	38	74	-0.7	-0.5	-0.2
Netherlands	68	91	-0.3	0.0	-0.3
Switzerland	129	172	-0.3	0.0	-0.3
UK	73	104	-0.4	-0.2	-0.2
Average WE	71	101	-0.4	-0.2	-0.2
Italy	23	56	-0.9	-0.7	-0.2
Spain	9	51	-1.7	-1.7	0.0
Average SE	16	54	-1.3	-1.2	-0.1
Average W. Europe	61	79	-0.4	-0.2	-0.2

Table 4: Living standards in 1950 taking the 'five-year-old' view

Countries	Welfare (I)	GDP per capita (II)	Difference (III)	LE (IV)	C (V)
USA	100	100	0	0	0
Denmark	103	76	0.3	0.2	0.1
Finland	30	46	-0.4	-0.3	-0.2
Sweden	94	72	0.3	0.2	0.0
Norway	72	82	-0.1	0.3	-0.4
Average NE	75	69	0.0	0.1	-0.1
Belgium	53	62	-0.2	-0.1	0.0
France	41	54	-0.3	-0.1	-0.1
Germany	36	42	-0.2	-0.1	-0.1
Netherlands	76	68	0.1	0.2	-0.1
Switzerland	120	121	0.0	0.0	0.0
UK	70	70	0.0	0.0	0.0
Average WE	66	69	-0.1	0.0	-0.1
Italy	32	41	-0.3	-0.2	0.0
Spain	21	28	-0.3	-0.4	0.1
Average SE	27	35	-0.3	-0.3	0.0
Average W. Europe	62	63	-0.1	0.0	-0.1

Figure 3: Welfare and income per capita growth rates with the 'newborn' perspective

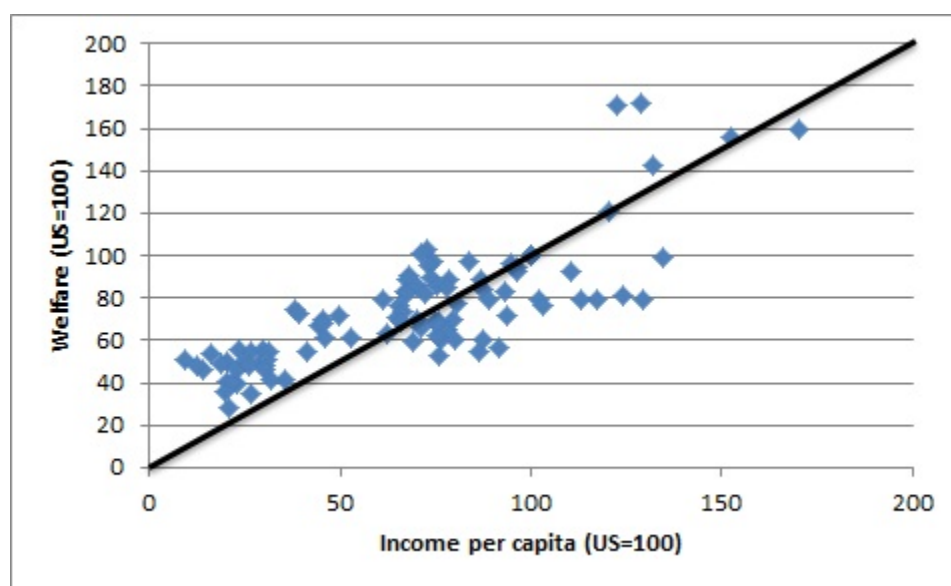


Figure 4: Unconditional welfare convergence during 1900-1950 with the 'newborn' perspective

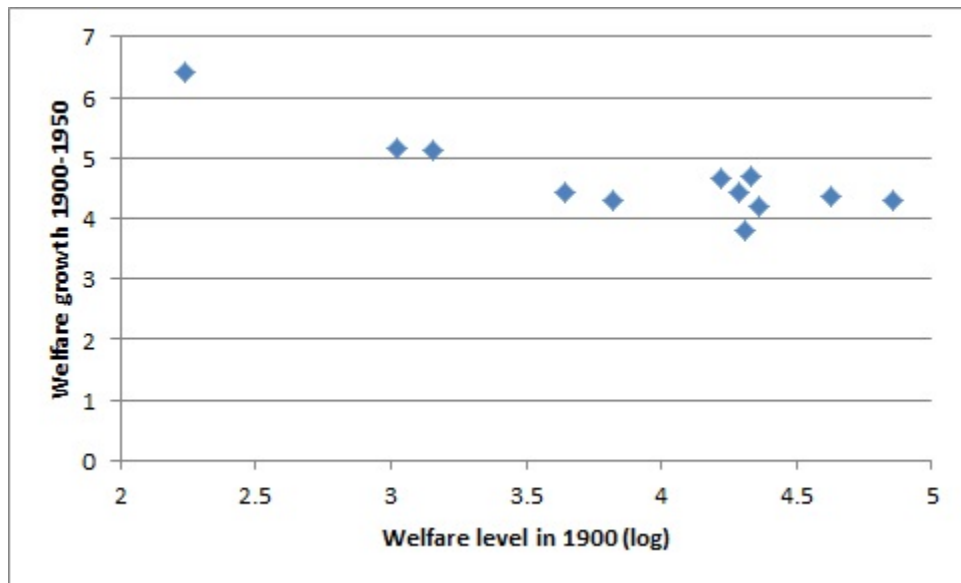


Figure 5: Unconditional welfare convergence during 1900-1950 with the 'five-year-old' perspective

