Do Overweight and Obesity Prevalence Rates Converge in Europe?

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Abstract

We exploit recently published data to evaluate the long-term evolution of overweight and obesity rates among European economies between 1975 and 2016. We find that overweight rates for both females and males converge in Europe. In particular, the convergence is driven by the nations in the EU. This fact is consistent with food patterns as well as trade, agricultural, and health policies that are common among EU members. Across our model specifications, the steady-state average overweight rate ranges between 60% and 77% for European females and lies above 82% for their male counterparts. Confidence intervals suggest that such gender differences are statistically significant. In the EU, the point estimates of these rates are 62% and 91% respectively. Obesity prevalence in Europe would reach long-term rates of 39% and 45% for females and males respectively, whereas these rates would be similar in the EU (approximately 28%).

JEL Codes: I12; I31; O47.
Keywords: obesity prevalence rates, overweight, dietary convergence, European Union.

1 Introduction

Overweight and obesity are associated with adverse health consequences (type 2 diabetes, cardiovascular diseases, and increased cancer risk, among others) and negative economic outcomes at the individual and aggregate levels (e.g., lower wages, lower probability of employment, and large external costs related to increased healthcare utilization).[1] Estimated trends in Europe, for example, indicate that the average overweight (obesity) prevalence has reached 54% (24%) in women and around 66% (23%) in men (NCD Risk Factor Collaboration 2017; henceforth referred to as NCD-RisC; see also Table 1).[2] In spite of the substantial heterogeneity in Europe, recent evidence suggests that such economies converge in terms of their average BMIs (Duncan and Toledo, 2018). In the same vein, consider the case of obesity among female individuals in Austria and Bulgaria. According to data from NCD-RisC, in 1975, the obesity rate of Austrian females was 9%, whereas that of Bulgarian females was about 17%: an initial difference of 8 percentage points. Surprisingly, the rate for Austrian females increased more rapidly than its Bulgarian counterpart over the last decades. By 2016, the gap between these rates became nil and both Austrian and Bulgarian females showed an obesity rate around 22%. To understand how regional differences have evolved historically, we evaluate whether initial cross-country differences in overweight and obesity rates tend to vanish over time. Because convergence is not necessarily desirable per se and depends on the steady-state level the country approaches, we also estimate the corresponding long-run prevalence rates.

Convergence in body weights across nations can be understood from two nonantagonistic theoretical perspectives. In public health, the nutrition transition model (Popkin, 1993) states that, if globalization induces the gradual adoption of diets and habits of physical activity similar to Western patterns, we would expect convergence in body weights across countries. In particular, Popkin (1993) and Popkin and Gordon-Larsen (2004) claim that nations seem to be converging on a pattern of diet that is high in saturated fat, sugar, and refined foods and low in fiber, as well as on lifestyles characterized by lower levels of physical activity.

In a recent contribution, Duncan and Toledo (2018) show that convergence in body weights is also consistent with the rational eating model used in health economics (Philipson and Posner, 1999; and Levy, 2002; among others). In this model, two representative individuals that differ only in their initial body weights converge in the long run because the individual with the lower initial weight gains weight faster than the individual with the higher initial weight. Given that the former individual is further from her steady-state weight, the utility from increasing consumption is larger than the disutility from gaining weight compared to the latter individual. In addition, if the ideal weight equals the healthy level, the model predicts that the optimal steady-state weight will be above such a healthy level (Levy, 2002).[3]

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[1] Some relatively minor health issues related to overweight such as pains, aches, and sleep disturbances are just the effect of the physical burden of the excess adipose tissue itself (Lehnert *et al.*, 2013). According to Cawley and Meyerhoefer (2012), in 2005, about 88% of the total medical costs attributable to obesity-related illnesses in the US were paid by health insurance companies, Medicare, and Medicaid. Tsai *et al.* (2011) find that the incremental per capita cost of overweight is approximately 10% greater, and that of obesity almost 43% greater, than the cost of normal-weight individuals. See also Cawley (2015).

[2] An overweight (obesity) prevalence rate is the percentage of the population with a body mass index (BMI; kg/m^2) equal to or more than 25 (30). The World Health Organization (2000) regards any BMI between 18.5 and 24.99 as normal weight.

[3] Under the additional assumption of a symmetric distribution of body weights, the model would imply a steady-state overweight prevalence rate higher than 50%. Interestingly, the US and Europe show overweight rates above 50% (see Table 1).

Based on these theoretical frameworks, we estimate dynamic panel models to test whether convergence in overweight and obesity rates exists and quantify the average long-term overweight and obesity rates. We use a recently published collection of prevalence rates for a large set of developing and advanced economies between 1975 and 2016, employ a consistent and efficient estimator following Kiviet (1995) and Bruno (2005), and check the sensitivity of our results in various dimensions.

Following a general-to-specific approach, we test for convergence globally, then regionally. Given the lack of evidence on convergence globally and in other world regions, we focus on the converging trends in Europe to estimate long-run prevalence rates. We find that the overweight rates for both females and males converge in Europe. In particular, the convergence is driven by EU members. This fact might be related to food patterns as well as trade, agricultural, and health policies that are common among EU members. In our alternative specifications, the steady-state overweight rate ranges between 60% and 77% for European females and between 82% and 99% for their male counterparts. In the European Union, our baseline point estimates are 62% and 91% respectively. Obesity prevalence in Europe would reach long-term rates of 39% and 45% for females and males respectively. These rates are significantly different from those in the EU (approximately 28%). To put these findings in a wider international context, given the 2016 overweight and obesity rates for females in the US (65% and 39% respectively; see also Table 1), our estimates suggest that females in the EU will be relatively less obese, even in the long run, than were their American counterparts in 2016, unless a structural change modifies the recently observed trends. Confidence intervals indicate that the gender differences in long-term overweight rates are statistically significant. We argue that these differences are related to heterogeneities observed in the marriage and labor markets.

Our study is related to several strands of literature. There is a relatively small, but growing, body of literature that explores convergence in nutritional and obesity-related indicators (daily calorie supplies, protein supplies, prevalence rates, and BMI). Hobijn and Franses (2001) find convergence in daily calorie supply and protein supply but only in certain groups of countries. Kenny (2005) provides evidence of convergence in calorie intake in a sample of developing and advanced economies. Li and Wang (2016) evaluate convergence in prevalence rates across US states. More recently, Duncan and Toledo (2018) test for convergence in BMIs across countries, whereas Nghiem *et al.* (2018) test for convergence in BMI changes across advanced countries. In contrast, we test for convergence in overweight and obesity rates globally and find a converging group of countries in the European sample.[4] Even though the BMI mean is a relevant feature of the distribution of (height-adjusted) weights, overweight and obesity prevalence rates are also important dimensions for the analysis of a nation's health and the formulation of policy recommendations. Moreover, two countries that have the same average BMI might also show different obesity rates.

Our analysis complements studies that add evidence to the predictions of the rational eating model. While convergence in per capita incomes is a prediction of the neoclassical growth model, convergence in body weights is a logical implication of the rational eating model, which has been intensively developed over the last two decades (e.g., Philipson and Posner, 1999; Levy, 2002; Dragone, 2009; Dragone and Savorelli, 2012; Buttet and Dolar, 2015). Variants of this model have been tested using data at individual level (e.g., Burke and Heiland, 2007; Lakdawalla and Philipson, 2009). We contribute to the literature by providing evidence of overweight in the long run and using aggregate prevalence rates across nations.

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[4] Using individual data, convergence analyses were also performed by Zhang and Wang (2004) for a sample of US adults, and Wolff *et al.* (2006) using data on the adult population of Geneva, Switzerland.

To the extent that we provide estimates of long-term overweight and obesity prevalence rates, this study can be compared with articles by health and statistics scholars that forecast such prevalence rates and BMI over long periods (e.g., Kelly *et al.*, 2008; Wang *et al.*, 2008; Mills, 2009; Stamatakis *et al.*, 2010; Haby *et al.*, 2011; Wang *et al.*, 2011; Finkelstein *et al.*, 2012; Majer *et al.*, 2013). Our findings back those models that predict a plateauing of prevalence rates—especially for European female adults—over those that forecast unbounded growth in obesity-related indicators (Wang *et al.*, 2011). Additionally, our estimates of long-run prevalence rates can be viewed as upper bounds of forecast intervals for the next few decades.

The rest of the paper proceeds as follows. The next section presents the data, empirical models, and hypotheses. Section 3 discusses the main results and robustness checks. Sections 4 and 5 provide a discussion, policy implications, and concluding remarks.

2 Empirical Strategy

2.1 Data

The data come from NCD-RisC, which reports prevalence rates for female and male adults (aged 20 and over) from each country for the 1975–2016 period. This database is suitable for a study of convergence due to its long-run series and the coverage of a thorough collection of nations. The data collection considers 2416 population-based measurement studies, with more than 125.7 million adult participants in 200 countries and territories. As with any comprehensive cross-country database, the NCD-RisC data also show some potential issues regarding information quality. Naturally, the prevalence rates from the earlier years of the sample (especially during the 1970s) and those from low-income developing countries might present more uncertainty and wider confidence intervals. We deal with this possible limitation by only drawing those countries with information of GDP per capita available. Additionally, we analyze restricted samples starting in 1980 and select subsets of countries as part of the robustness checks (see Section 3.2).

Our world sample consists of 172 economies. We split this sample into different regions but, for the sake of simplicity, we opt to group countries into European and non-European regions. Other subdivisions of the non-European sample (e.g., Asia-Oceania, Africa, and the Americas) provide similar conclusions.[5] That said, we adopt a wide definition of the European region to maximize the number of observations in our main sample.

Table 1 shows the evolution of the global obesity epidemic. The table shows the rates of overweight and obesity for these groups of countries between 1975 and 2016 and lists all the countries. Given that the US is the advanced economy with the highest (or one of the highest) rates of adult obesity, the same table also reports its prevalence rates. According to NCD-RisC (2017), the US has the highest male overweight and obesity rates (75% and 37% respectively) and the fourth- and third-highest female overweight and obesity rates (65% and 39%) among the member countries of the Organisation for Economic Co-operation and Development in 2016.

[Table 1 about here.]

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[5] See Tables A1 and A2 in the Appendix for the results of lack of convergence in the global and non-European samples.

Table 2 provides the main descriptive statistics calculated over the 1975–2016 period. We use unadjusted series—those that were not calculated using covariates (income, urban population rate, and schooling years)—to minimize any artificial influence from such variables on our results.[6] Time series of overweight and obesity are age-standardized and do not use self-reported heights and weights. This is an important feature because self-reported data are usually subject to biases that differ by geography, time, age, sex, and socioeconomic characteristics (NCD-RisC, 2017).

[Table 2 about here.]

2.2 Models and Hypotheses

We follow an empirical strategy to test for convergence widely used in economics (e.g., Durlauf *et al.*, 2009) but considering that the variable under analysis is a prevalence rate. In this case, let $p_t \in (0,\ 1)$ be the rate of overweight or obesity. Given that a linear model might predict values for the prevalence rate outside the unit interval, we follow Davidson and MacKinnon (1993) and employ a transformation such that $y_t = ln[p_t/(1-p_t)]$. Then, $y_t \in\ (-\infty,\ \infty)$ and does not require one to leave the regression framework.[7] First, we estimate

$$\Delta y_{it} = \alpha + \beta y_{it-1} + \varepsilon_{it}, \tag{1}$$

where variables are indexed for every period t and country i, α and β are parameters of interest, and ε_{it} is a zero-mean error term that contains country fixed effects.

First, we hypothesize that countries do not converge in prevalence rates of overweight. Symbolically, $H_0 : \beta \geq 0$, $H_1 : \beta < 0$. If we reject the null of no convergence, then we can determine the long-term prevalence rate. In a deterministic steady-state equilibrium, $p_t = p_{t-1} = p^*$. Therefore, by equation (1), $y_t = y_{t-1} = y^* = -\alpha/\beta$. We use the following expression to calculate the steady-state prevalence rates:

$$p^* = \frac{1}{1+e^{-y^*}} = \frac{1}{1+e^{\alpha/\beta}}. \tag{2}$$

Second, we assess the probability that the long-run overweight prevalence rate is higher than the one currently observed in the US. Symbolically, $H_0 : p^* \geq pr_{US16}, H_1 : p^* < pr_{US16}$, where $pr_{US16} = 0.65$ for females and $pr_{US16} = 0.75$ for males (see Table 1). For the case of obesity, our concern is whether the majority of the (female or male) population will be obese. That is, $H_0 : p^* \geq 0.5, H_1 : p^* < 0.5$.[8]

Given the endogeneity of our main regressor, we estimate the panel model using a bias-corrected fixed effects estimator (Kiviet, 1995), which shows a lower bias and a lower root mean squared error compared to generalized method of moments estimators (Kiviet, 1995; Bruno, 2005). Monte Carlo evidence from comparative studies also supports this claim (Flannery and Hankins, 2013; Dang *et al.*, 2015). The

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[6] This dataset was kindly provided by the NCD-RisC.

[7] Even though this is an appealing feature, the transformation might somewhat reduce the dispersion of the original series. For that reason, we also include alternative estimates using the original (untransformed) series in a linear framework. More on this below.

[8] It is worth pointing out that, a long-term prevalence rate very close to one (e.g., 0.999) in the model with transformed rates might be the result of persistent growth such that the best prediction for that rate is that it will continue increasing. Since the logistic transformation predicts rates between zero and one, a long-term prevalence rate equal to one could be viewed as a signal of no convergence.

related p-values, standard errors, and confidence intervals are calculated using bootstrapping and 2000 replications.

The sensitivity of our results is verified using (i) linear models (i.e., untransformed prevalence rates, $y_t = p_t$ in (1)),[9] (ii) different sub-samples (subregions or dropping the initial periods of higher uncertainty), and (iii) control variables. For (iii), we extend the previous model and estimate:

$$\Delta y_{it} = \alpha + \beta y_{it-1} + \gamma' \mathbf{x}_{it} + \varepsilon_{it}, \tag{3}$$

where γ is a column vector of parameters, and $\mathbf{x}_{it}$ is a column vector of controls in deviations from long-run levels, so that $\mathbf{x}_{it} = \mathbf{0}$ in the steady state. We include an indicator of globalization, GDP per capita, a human capital index, and urbanization rate. These covariates are commonly proposed in the literature (e.g., De Vogli *et al.*, 2014; Goryakin and Suhrcke, 2014; Goryakin *et al.* 2015; Costa-Font and Mas, 2016). Long-run components are estimated using a Hodrick-Prescott trend for GDP per capita, and sample means for globalization, human capital, and urbanization. The description of these indicators and their sources are provided in the Appendix. Descriptive statistics of the raw covariates are shown in Table 2.

3 Results

3.1 Main Findings

We begin by testing for convergence globally (see Tables B1 and B2 in the Appendix).[10] Our tests indicate the absence of convergence for overweight and obesity rates among females and males in all the world regions except for Europe. Given these results, we investigate the converging trends in Europe and provide a deeper analysis of that sample. Table 3 displays the parameter estimates and standard errors for the model with transformed overweight rates (columns (1)–(2)) and the linear model (columns (3)–(4)). The table also shows the steady-state prevalence rate, its 95% confidence interval, and the p-values related to the null hypotheses of no convergence and that the steady-state overweight rate could be greater than the US overweight rate observed in the last year of the sample.

[Table 3 about here.]

Three conclusions emerge from this table. First, convergence in overweight rates is present for both genders. As expected, the slope parameter is negative and statistically significant at conventional levels. The p-value for the null hypothesis of no convergence is even lower than 0.1%. Second, if trends continue (all else being equal), European nations will show high long-term overweight rates, on average. These results are not sensitive to the use of linear models (untransformed rates; see columns (3)–(4)). The p-value associated with the null hypothesis of an overweight rate higher than that of the US in 2016 suggests that in the long-term, Europeans' rates will almost surely surpass those recently observed for their American peers. Third, the steady-state overweight rate is 71% for females, whereas that of males is 98%. It is worth mentioning that confidence intervals for these estimates do not intersect, which denotes statistically significant differences.

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[9] In this case, it is straightforward to show that $p^* = -\alpha/\beta$.

[10] The estimates for the other world regions (Asia-Oceania, Africa, and the Americas) are available on request.

Similarly, columns (1)–(2) in Table 4 confirm the presence of convergence in obesity rates for both genders. In this case, the steady-state prevalence rate is 39% for females and approximately 45% for males. The p-value favors the hypothesis that the prevalence rate of obesity will not exceed 50%. In contrast to overweight rates, convergence in obesity rates depends on the type of model. Columns (3)–(4) in Table 4 report the absence of convergence using the linear model.

[Table 4 about here.]

3.2 Robustness Checks

To examine the robustness of our main findings we perform a number of exercises previously described in Section 2.2. Table 5 reports the results obtained when we drop the first quinquennium (years that show more uncertainty in the estimated rates; columns (1)–(2)) and when we estimate equation (3) including covariates of overweight (columns (3)–(4)). Because the inclusion of other variables leads to missing observations due to data availability (see Table 2), we also estimate equation (1) using the same number of observations (columns (5)–(6)). This allows us to isolate the effects and distinguish whether the differences are due to the inclusion of controls or the missing observations. Table 6 provides the results from analogous exercises using obesity rates. All these estimates use our preferred model with the logistic-transformed prevalence rates.

[Table 5 about here.]

Our results for overweight rates are not sensitive to these modifications and the main conclusions are unchanged. Overall, we find convergence and the long-term average prevalence rate ranges between 60% and 69% for European females and between 82% and 99% for European males. For obesity rates, we obtain convergence as well except for the specification with controls and missing observations for males. Steady-state obesity rates vary from 31% to 39% among females and from 35% to 48% among males.

[Table 6 about here.]

Tables 7 and 8 investigate the results of splitting the European data into the EU member states and non-EU countries. Columns (1)–(4) in each table display estimates using transformed rates, whereas columns (5)–(8) provide estimates with the raw prevalence rates (linear models).

[Table 7 about here.]

Interestingly, our hypotheses of convergence and long-run overweight hold for the EU subsample, regardless of the use of transformed rates, but not for the rest of Europe. Long-term overweight rates are in the 62%-65% and 82%-91% ranges for females and males from the EU respectively.

Finally, Table 8 shows the estimates for obesity. Columns (1)–(4) indicate convergence in obesity rates for both genders and regions. However, the confidence interval of these rates is close or equal to 1, suggesting that the data do not allow us to infer the long-term obesity rate. As we can see, these results are sensitive to the use of transformed rates. In the former models, obesity in the EU would reach similar long-run rates for men and women: around 28%. These rates are significantly different from those estimated for Europe.

[Table 8 about here.]

In summary, our findings on convergence in overweight and long-term rates for both genders are relatively robust to the use of controls, restricted samples, and even untransformed prevalence rates. It is possible that the results are driven by the EU member states. Although we also find consistent results on convergence in obesity, they are particularly sensitive to the use of linear models. All in all, the results for females' rates are more robust than the results for males' rates.

4 Discussion

As shown in Table 2, overweight and obesity prevalence rates have been increasing worldwide during the last 42 years. Regardless of this trend, our results show evidence that overweight and obesity in Europe will tend to stabilize in the long run. In other words, countries could converge to similar steady-state prevalence rates. Furthermore, the average long-term obesity prevalence rate for the EU countries is significantly smaller than that of Europe, suggesting that such a convergence could be driven mainly by EU member states. This fact is likely related to food patterns and trade, agricultural, and health policies that are common among EU economies, as explained by Duncan and Toledo (2018).

The estimates of the average long-run prevalence rates suggest that European nations will converge to high overweight and obesity rates. Long-term rates of obesity could be higher for men than for women (45% vs. 39% respectively), reverting the trends observed over the last few decades of a larger obesity rate among women (see Table 1). Moreover, overweight and obesity rates for EU females would be approximately 62% and 28% respectively. To put these findings in a wider international context, we can compare rates between the US and the EU. Given the 2016 overweight and obesity rates of 65% and 39% for females in the US (see Table 1), the proportion of obese females in the EU in the long run will be relatively lower than that of the US in 2016, unless a structural change modifies the recently observed trends. In particular, the upper bound of the confidence interval for the long-term obesity rate of EU females is below the latest obesity rate of US females.

The results on convergence for female overweight and obesity rates are more robust than those for males. For that reason, we need to read our findings with caution. On the one hand, when males' overweight and obesity rates converge in Europe, they converge to alarming long-run overweight levels. On the other hand, when they do not converge, given that prevalence rates have upper bounds of 100% and show upward trends, that may reflect a long transition that should slow down in the future towards a high-level equilibrium that we are yet not able to identify with the current data. In that case, the best long-term prediction in terms of overweight rates is one that is very close to the upper bound. Put differently, the prevalence rates observed for males are not sufficiently informative to accurately detect convergence.[11]

Our findings reveal significant gender heterogeneities in long-run prevalence rates that might be associated with historical differences observed in Europe. These differences are likely related to three findings reported in the literature. First, in the marriage market, physical attractiveness tends to be more relevant to males' choice of women than to females' choice of men (Fisman *et al.*, 2006). Second, the obesity wage penalty appears to be greater for women than for men in some developed countries (Cawley, 2015). Third, since women are usually in charge of household chores regardless of their job

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[11] This is also the reason we avoid the word "divergence" and employ the term "no convergence" in this study.

status, physical activity could be more demanding for working females compared to working males (Wolf *et al.*, 2006). All these factors might induce European females to maintain a relatively lower weight than their male peers. The need for a deeper understanding of these differences is a promising opportunity for future research.

5 Concluding Remarks

We exploit the time and cross-sectional dimensions of recently published trends of prevalence rates to evaluate convergence in overweight and obesity across nations. Given the lack of evidence on convergence globally and in other world regions, we focus on the converging trends in Europe to estimate long-run prevalence rates. We find that males' overweight rate could converge to a level close to (or above) 90%. Their female counterparts show substantially lower long-term overweight rates. These estimates vary between 60% and 77% depending on the model specification. A similar gender difference is found for the obesity rates: between 31% and 39% for females and between 35% and 48% for males. The latter value, however, is not significantly different from 50%. Because convergence in body weights is attributed to convergence in diet and physical activities (Popkin, 1993), we believe that there is room to implement public policies to change the observed growth trends.

The accuracy of these estimates might be related to the degree of heterogeneity among European countries. We also evaluate convergence in the EU and find convergence and long-run overweight prevalence rates of 62% and 91% for women and men, respectively. Long-term obesity rates are comparatively similar (approximately 28%, although the confidence interval for males is wider).

Finally, if there is more uncertainty surrounding the future evolution of overweight rates in males, policy makers should put additional emphasis on understanding males' choices in terms of food and physical activities and the interaction of such choices with environmental factors. Because males from nations outside of Europe have also been experiencing a steeper growth trend in overweight and obesity, there must be some common factors that could be driving such a trend; technology, globalization, and the type of work are a few possibilities.

In non-European countries—predominantly developing economies—the average obesity rate for females has been increasing to the point where they are currently similar to those observed in Europe in 2016. However, the absence of convergence suggests that, if these trends continue, female obesity could be a more severe health problem in developing countries than in advanced economies. This would constitute a wake-up call requiring effective action.

A Data Appendix

With regard to world regions, the sample of 172 economies is distributed as follows: Africa (50 nations), Asia (40), Europe (45), Northern America (3), Latin America and the Caribbean (31), and Oceania (3). The variables used in the analysis are the following:

Overweight prevalence rate: percentage of the population with a body mass index equal to or more than 25. Source: NCD Risk Factor Collaboration (2017). The series are age-standardized and do not use self-reported height and weight. We use unadjusted data; that is, the data constructed by NCD-RisC without using covariates (income per capita, urbanization rate, and schooling) in order to minimize the possible artificial influence of such variables on body weight indicators.

Obesity prevalence rate: percentage of the population with a body mass index equal to or more than 30. Source: NCD Risk Factor Collaboration (2017). The series are age-standardized, and do not use self-reported height and weight, and we use unadjusted data.

Globalization index: the Swiss Economic Institute (KOF) index of globalization measures the economic, social, and political dimensions of globalization and comes from Gygli *et al.* (2018).

GDP per capita: Expenditure-side real GDP at chained PPPs (in mil. 2011 US$ dollars) divided by population (in mil. of persons). Both series come from Feenstra *et al.*, (2015). Source: Penn World Tables 9.0.

Human capital index: based on years of schooling and returns to education; see human capital in Feenstra *et al.*, (2015). Source: Penn World Tables 9.0.

Urbanization rate: percentage of population living in urban areas as defined by national statistical offices. It is calculated using World Bank population estimates and urban ratios from the United Nations World Urbanization Prospects. Source: World Development Indicators (World Bank).

B Additional Results: Global and Non-European Samples

Table B1: No Convergence in the Global and Non-European Samples
Dependent Variable: Annual Change in Transformed Overweight Prevalence Rate

	Global Sample		**Non-European Sample**	
	Female (1)	**Male (2)**	**Female (3)**	**Male (4)**
Constant	0.023***	0.032***	0.029***	0.031***
	(0.0003)	(0.0004)	(0.0009)	(0.0004)
Lagged transformed prevalence rate	0.0045***	0.0051***	0.0074***	0.0028***
	(0.0003)	(0.0003)	(0.0008)	(0.0002)
No. of countries	172	172	127	127
No. of periods	42	42	42	42
No. of observations	7224	7224	5334	5334
Steady-state prevalence rate	0.007	0.002	0.019	0.000
Convergence	No	No	No	No
P-value (H_0: no convergence)	1.000 (1.000)	1.000 (1.000)	1.000 (1.000)	1.000 (1.000)

Notes: * p-value $<$ 0.1, ** p-value $<$ 0.05, *** p-value $<$ 0.01. We use a bias-corrected fixed effects estimator (Kiviet, 1995; Bruno, 2005). Models include fixed country effects and a common trend component (log-linear trend). P-values, standard errors (in parentheses), and confidence intervals are calculated using 2000 bootstrap replications. P-value (H_0: no convergence) is related to the null hypothesis that the slope of the lagged (transformed) prevalence is equal to or higher than 0. The p-value for the same null hypothesis but using the linear model is reported in parentheses.

Table B2: No Convergence in the Global and Non-European Samples
Dependent Variable: Annual Change in Transformed Obesity Prevalence Rate

	Global Sample		**Non-European Sample**	
	Female	**Male**	**Female**	**Male**
	(1)	**(2)**	**(3)**	**(4)**
Constant	0.0313***	0.0315***	0.0458***	0.0320***
	(0.0006)	(0.0006)	(0.0010)	(0.0008)
Lagged transformed prevalence rate	0.001***	-0.0017***	0.0044***	-0.0020***
	(0.0002)	(0.0001)	(0.0003)	(0.0001)
No. of countries	172	172	127	127
No. of periods	42	42	42	42
No. of observations	7224	7224	5334	5334
Steady-state prevalence rate	0.000	1.000	0.000	1.000
Convergence	No	No^{a}	No	No^{a}
P-value (H_0: no convergence)	1.000 (1.000)	0.000 (1.000)	1.000 (1.000)	0.000 (1.000)

Notes: * p-value < 0.1, ** p-value < 0.05, *** p-value < 0.01. (*a*) A long-run prevalence rate very close to one (e.g., 0.999) might be the result of a persistent growth such that the best prediction for that rate is that it will continue increasing. Since the logistic transformation predicts rates between zero and one, a long-term prevalence rate equals to one could be viewed as a signal of no convergence. We use a bias-corrected fixed effects estimator (Kiviet, 1995; Bruno, 2005). Models include fixed country effects and a common trend component (log-linear trend). P-values, standard errors (in parentheses), and confidence intervals are calculated using 2000 bootstrap replications. P-value (H_0: no convergence) is related to the null hypothesis that the slope of the lagged (transformed) prevalence is equal to or higher than 0. The p-value for the same null hypothesis but using the linear model is reported in parentheses.

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Table 1: Overweight and Obesity Prevalence Rates

Variable	**1975 Mean**	**2016 Mean**	**1975–2016 Change**
A. European sample			
Overweight rate			
Female	0.42	0.54	0.12
Male	0.44	0.66	0.22
Obesity rate			
Female	0.14	0.24	0.10
Male	0.08	0.23	0.15
B. Non-European sample			
Overweight rate			
Female	0.28	0.49	0.21
Male	0.20	0.41	0.21
Obesity rate			
Female	0.08	0.22	0.14
Male	0.03	0.13	0.10
C. United States			
Overweight rate			
Female	0.38	0.65	0.27
Male	0.48	0.75	0.27
Obesity rate			
Female	0.14	0.39	0.25
Male	0.11	0.37	0.26
D. Global sample			
Overweight rate			
Female	0.32	0.51	0.19
Male	0.26	0.47	0.21
Obesity rate			
Female	0.09	0.23	0.14
Male	0.04	0.16	0.12

Notes: Overweight (obesity) rate is the proportion of the population with a BMI above 25 (30) kg/m^2 (females and males aged 20 and over). Source: NCD Risk Factor Collaboration (2017). Average rates across countries are calculated for panels A, B, and D. The European sample includes the following 45 countries: Albania, Armenia, Austria, Azerbaijan, Belarus, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Georgia, Germany, Greece, Hungary, Iceland, Ireland, Italy, Kazakhstan, Latvia, Lithuania, Luxembourg, Macedonia, Malta, Moldova, Montenegro, the Netherlands, Norway, Poland, Portugal, Romania, the Russian Federation, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, Ukraine, and the United Kingdom. The non-European sample includes the following 127 countries and territories: Algeria, Angola, Antigua and Barbuda, Argentina, Australia, the Bahamas, Bahrain, Bangladesh, Barbados, Belize, Benin, Bermuda, Bhutan, Bolivia, Botswana, Brazil, Brunei, Burkina Faso, Burundi, Cabo Verde, Cambodia, Cameroon, Canada, Central African Republic, Chad, Chile, China, China (Hong Kong SAR), Colombia, Comoros, Congo, Costa Rica, Côte d'Ivoire, Djibouti, Dominica, the Dominican Republic, DR Congo, Ecuador, Egypt, El Salvador, Equatorial Guinea, Ethiopia, Fiji, Gabon, Gambia, Ghana, Grenada, Guatemala, Guinea, Guinea Bissau, Haiti, Honduras, India, Indonesia, Iran, Iraq, Israel, Jamaica, Japan, Jordan, Kenya, Kuwait, Kyrgyzstan, Lao People's Democratic Republic, Lebanon, Lesotho, Liberia, Madagascar, Malawi, Malaysia, the Maldives, Mali, Mauritania, Mauritius, Mexico, Mongolia, Morocco, Mozambique, Myanmar, Namibia, Nepal, New Zealand, Nicaragua, Niger, Nigeria, Oman, Pakistan, Panama, Paraguay, Peru, the Philippines, Qatar, Rwanda, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, São Tomé and Príncipe, Saudi Arabia, Senegal, the Seychelles, Sierra Leone, Singapore, South Africa, South Korea, Sri Lanka, Sudan, Suriname, Swaziland, the Syrian Arab Republic, Taiwan, Tajikistan, Tanzania, Thailand, Togo, Trinidad and Tobago, Tunisia, Turkmenistan, Uganda, the United Arab Emirates, the United States of America, Uruguay, Uzbekistan, Venezuela, Vietnam, Yemen, Zambia, and Zimbabwe.

Table 2: Descriptive Statistics

Variable	**Observations**	**Mean**	**Standard Deviation**	**Minimum**	**Median**	**Maximum**
A. European sample						
Overweight rate						
Female	1890	0.48	0.06	0.32	0.48	0.71
Male	1890	0.55	0.08	0.31	0.55	0.72
Obesity rate						
Female	1890	0.18	0.05	0.07	0.19	0.41
Male	1890	0.14	0.05	0.04	0.14	0.28
Other variables						
Globalization	1558	65.05	17.95	23.92	68.15	92.84
GDP per capita	1515	21070.4	13770.3	1251.4	19562.4	95175.7
Human capital	1365	2.89	0.43	1.36	2.93	3.73
Urbanization	1785	65.97	13.94	31.29	66.84	97.82
B. Non-European sample						
Overweight rate						
Female	5334	0.38	0.16	0.07	0.38	0.75
Male	5334	0.30	0.17	0.03	0.24	0.75
Obesity rate						
Female	5334	0.14	0.10	0.00	0.12	0.47
Male	5334	0.07	0.07	0.00	0.04	0.37
Other variables						
Globalization	4810	42.51	14.89	12.91	40.66	89.65
GDP per capita	5006	9954.7	17312.7	142.4	4340.8	221818.5
Human capital	4116	1.96	0.63	1.01	1.85	3.72
Urbanization	5040	47.12	24.35	3.52	43.01	100
C. Global sample						
Overweight rate						
Female	7224	0.41	0.15	0.07	0.44	0.75
Male	7224	0.36	0.19	0.03	0.39	0.75
Obesity rate						
Female	7224	0.15	0.09	0.00	0.15	0.47
Male	7224	0.09	0.07	0.00	0.08	0.37
Other variables						
Globalization	6368	48.02	18.44	12.91	45.20	92.84
GDP per capita	6521	12537.2	17209.2	142.4	6423.71	221818.5
Human capital	5481	2.19	0.71	1.01	2.14	3.73
Urbanization	6825	52.05	23.61	3.52	51.59	100.00

Notes: Overweight (obesity) rate is the proportion of the population with a BMI above 25 (30) kg/m^2 (for females and males aged 20 and over). Statistics are computed for 45 countries over the 1975-2016 period. Source: NCD Risk Factor Collaboration (2017). The KOF Globalization Index comes from Gygli *et al.* (2018). GDP per capita is real GDP at chained PPP (in 2011 US dollars). Human capital index is based on years of schooling and returns to education. Real GDP and human capital series are from Penn World Tables 9.0 (Feenstra *et al.*, 2015). The urbanization rate (%) series are from the World Bank's World Development Indicators. These variables are for the 1975–2014 period. For the list of countries in each group, see the notes in Table 1.

Table 3: Convergence and Long-run Prevalence Rates — Main Results (Europe, full sample)
Dependent Variable: Annual Change in (Transformed) Overweight Prevalence Rate

	Female **(1)**	**Male** **(2)**	**Female** **(3)**	**Male** **(4)**
Constant	0.008***	0.019***	0.006***	0.008***
	(0.0002)	(0.0005)	(0.0002)	(0.0002)
Lagged (transformed) prevalence rate	-0.0087***	-0.0046***	-0.0073***	0.0087***
	(0.0005)	(0.0006)	(0.0005)	(0.0006)
No. of countries	45	45	45	45
No. of periods	42	42	42	42
No. of observations	1890	1890	1890	1890
Logistic transformation	Yes	Yes	No	No
Convergence	Yes	Yes	Yes	Yes
Steady-state prevalence rate	0.712	0.982	0.773	0.970
95% confidence interval	[0.685 0.750]	[0.956 0.996]	[0.745 0.861]	[0.919 1.146]
P-value (H_0: no convergence)	0.000	0.000	0.000	0.000
P-value (H_0: prevalence $\geq PR_{US16}$)	1.00	1.00	1.00	1.00

Notes: * p-value < 0.1, ** p-value < 0.05, *** p-value < 0.01. We use a bias-corrected fixed effects estimator (Kiviet, 1995; Bruno, 2005). Models include fixed country effects and a common trend component (log-linear trend). P-values, standard errors (in parentheses), and confidence intervals are calculated using 2000 bootstrap replications. P-value (H_0: no convergence) is related to the null hypothesis that the slope of the lagged (transformed) prevalence is equal to or higher than 0. If this p-value is lower than 0.05, we report "Yes" in the *Convergence* line. The steady-state prevalence rate is [1/(1+exp(intercept/slope)] in the model with logistic transformation and -(intercept/slope) in the linear model. P-value (H_0: prevalence $\geq PR_{US16}$) is related to the null hypothesis that the long-run prevalence rate is greater than or equal to the 2016 prevalence rate of the US (0.65 for females and 0.75 for males).

Table 4: Convergence and Long-run Prevalence Rates — Main Results (Europe, full sample)
Dependent Variable: Annual Change in (Transformed) Obesity Prevalence Rate

	Female **(1)**	**Male** **(2)**	**Female** **(3)**	**Male** **(4)**
Constant	-0.005***	-0.003***	-0.001***	0.001***
	(0.0010)	(0.0021)	(0.0001)	(0.0001)
Lagged (transformed) prevalence rate	-0.0104***	-0.0138***	0.0135***	0.0321***
	(0.0005)	(0.0008)	(0.0014)	(0.0066)
No. of countries	45	45	45	45
No. of periods	42	42	42	42
No. of observations	1890	1890	1890	1890
Logistic transformation	Yes	Yes	No	No
Convergence	Yes	Yes	No	No
Steady-state prevalence rate	0.392	0.447	...	...
95% confidence interval	[0.363 0.439]	[0.404 0.556]	...	...
P-value (H_0: no convergence)	0.000	0.000	1.000	1.000
P-value (H_0: prevalence ≥ 0.5)	0.000	0.076	...	...

Notes: * p-value < 0.1, ** p-value < 0.05, *** p-value < 0.01. We use a bias-corrected fixed effects estimator (Kiviet, 1995; Bruno, 2005). Models include fixed country effects and a common trend component (log-linear trend). P-values, standard errors (in parentheses), and confidence intervals are calculated using 2000 bootstrap replications. P-value (H_0: no convergence) is related to the null hypothesis that the slope of the lagged (transformed) prevalence is equal to or higher than 0. If this p-value is lower than 0.05, we report "Yes" in the *Convergence* line. The steady-state prevalence rate is [1/(1+exp(intercept/slope)] in the model with logistic transformation and -(intercept/slope) in the linear model. P-value (H_0: prevalence ≥ 0.5) is related to the null hypothesis that the long-run prevalence rate is greater than or equal to 0.5.

Table 5: Convergence and Long-run Prevalence Rates—Robustness Checks (Europe, restricted samples and controls)
Dependent Variable: Annual Change in Transformed Overweight Prevalence Rate

	Female **(1)**	**Male** **(2)**	**Female** **(3)**	**Male** **(4)**	**Female** **(5)**	**Male** **(6)**
Constant	0.008***	0.019***	0.009***	0.025***	0.006***	0.021***
	(0.0002)	(0.0005)	(0.0005)	(0.0007)	(0.0003)	(0.0006)
Lagged transformed prevalence rate	-0.011***	-0.016***	-0.014***	-0.014***	-0.015***	-0.006***
	(0.0006)	(0.0007)	(0.0008)	(0.0009)	(0.0007)	(0.0007)
No. of countries	45	45	39	39	39	39
No. of periods (average)	37	37	34	34	34	34
No. of observations	1665	1665	1333	1333	1333	1333
Control variables	No	No	Yes	Yes	No	No
Sample used	1980-2016	1980-2016	1975-2016	1975-2016	1975-2016	1975-2016
Convergence	Yes	Yes	Yes	Yes	Yes	Yes
Steady-state prevalence rate	0.658	0.987	0.692	0.824	0.602	0.973
95% confidence interval	[0.640 0.687]	[0.962 0.999]	[0.663 0.747]	[0.801 0.864]	[0.586 0.627]	[0.941 0.993]
P-value (H_0: no convergence)	0.000	0.000	0.000	0.000	0.000	0.000
P-value (H_0: prevalence $\geq PR_{US16}$)	0.756	1.000	0.971	1.000	0.000	1.000

Notes: * p-value < 0.1, ** p-value < 0.05, *** p-value < 0.01. All the models use logistic-transformed prevalence rates. We use a bias-corrected fixed effects estimator (Kiviet, 1995; Bruno, 2005). Models include fixed country effects and a common trend component (log-linear trend). P-values, standard errors (in parentheses), and confidence intervals are calculated using 2000 bootstrap replications. P-value (H_0: no convergence) is related to the null hypothesis that the slope of the lagged transformed prevalence is equal to or higher than 0. If this p-value is lower than 0.05, we report "Yes" in the *Convergence* line. The steady-state prevalence rate is [1/(1+exp(intercept/slope)] in the model with logistic transformation. P-value (H_0: prevalence $\geq PR_{US16}$) is related to the null hypothesis that the long-run prevalence rate is greater than or equal to the 2016 prevalence rate of the US (0.65 for females and 0.75 for males).

Table 6: Convergence and Long-run Prevalence Rates—Robustness Checks (Europe, restricted samples and controls)
Dependent Variable: Annual Change in Transformed Obesity Prevalence Rate

	Female (1)	**Male (2)**	**Female (3)**	**Male (4)**	**Female (5)**	**Male (6)**
Constant	-0.008***	-0.001	-0.005***	0.377***	-0.012***	-0.011***
	(0.0011)	(0.0023)	(0.0016)	(0.0050)	(0.0014)	(0.0031)
Lagged transformed prevalence rate	-0.013***	-0.014***	-0.012***	0.124***	-0.014***	-0.017***
	(0.0006)	(0.0010)	(0.0007)	(0.0006)	(0.0007)	(0.0012)
No. of countries	45	45	39	39	39	39
No. of periods (average)	37	37	34	34	34	34
No. of observations	1665	1665	1333	1333	1333	1333
Control variables	No	No	Yes	Yes	No	No
Sample used	1980-2016	1980-2016	1975-2016	1975-2016	1975-2016	1975-2016
Convergence	Yes	Yes	Yes	No	Yes	Yes
Steady-state prevalence rate	0.353	0.475	0.389	...	0.310	0.351
95% confidence interval	[0.332 0.385]	[0.435 0.606]	[0.347 0.468]	...	[0.290 0.341]	[0.342 0.513]
P-value (H_0: no convergence)	0.000	0.000	0.000	1.000	0.000	0.000
P-value (H_0: prevalence ≥ 0.5)	0.000	0.296	0.000	...	0.000	0.001

Notes: * p-value < 0.1, ** p-value < 0.05, *** p-value < 0.01. All the models use logistic-transformed prevalence rates. We use a bias-corrected fixed effects estimator (Kiviet, 1995; Bruno, 2005). Models include fixed country effects and a common trend component (log-linear trend). P-values, standard errors (in parentheses), and confidence intervals are calculated using 2000 bootstrap replications. P-value (H_0: no convergence) is related to the null hypothesis that the slope of the lagged transformed prevalence is equal to or higher than 0. If this p-value is lower than 0.05, we report "Yes" in the *Convergence* line. The steady-state prevalence rate is [1/(1+exp(intercept/slope)] in the model with logistic transformation. P-value (H_0: prevalence ≥ 0.5) is related to the null hypothesis that the steady-state prevalence rate is greater than or equal to 0.5.

Table 7: Convergence and Long-run Prevalence Rates — EU and Non-EU samples
Dependent Variable: Annual Change in (Transformed) Overweight Prevalence Rate

	EU sample		**Non-EU sample**		**EU sample**		**Non-EU sample**	
	Female (1)	**Male (2)**	**Female (3)**	**Male (4)**	**Female (5)**	**Male (6)**	**Female (7)**	**Male (8)**
Constant	0.007***	0.019***	0.009***	0.020***	0.008***	0.011***	0.002***	0.004***
	(0.0003)	(0.0006)	(0.0003)	(0.0009)	(0.0002)	(0.0003)	(0.0004)	(0.0003)
Lagged transformed prevalence rate	-0.0138***	-0.0079***	-0.0003	0.0020**	-0.0119***	-0.0130***	0.0013	0.0007
	(0.0007)	(0.0007)	(0.0009)	(0.0009)	(0.0006)	(0.0008)	(0.0009)	(0.0010)
No. of countries	28	28	17	17	28	28	17	17
No. of periods	42	42	42	42	42	42	42	42
No. of observations	1176	1176	714	714	1176	1176	714	714
Control variables	No	No	No	No	No	No	No	No
Logistic transformation	Yes	Yes	Yes	Yes	No	No	No	No
Convergence	Yes	Yes	No	No	Yes	Yes	No	No
Steady-state prevalence rate	0.620	0.914	...	...	0.648	0.822	...	...
95% confidence interval	[0.604 0.647]	[0.870 0.954]	...	...	[0.639 0.700]	[0.806 0.959]	...	...
P-value (H_0: no convergence)	0.000	0.000	0.350	0.984	0.000	0.000	0.934	0.732
P-value (H_0: prevalence $\geq PR_{US16}$)	0.001	1.000	...	...	0.459	1.000	...	...

Notes: * p-value < 0.1, ** p-value < 0.05, *** p-value < 0.01. All the models use logistic-transformed prevalence rates. We use a bias-corrected fixed effects estimator (Kiviet, 1995; Bruno, 2005). Models include fixed country effects and a common trend component (log-linear trend). P-values, standard errors (in parentheses), and confidence intervals are calculated using 2000 bootstrap replications. P-value (H_0: no convergence) is related to the null hypothesis that the slope of the lagged transformed prevalence is equal to or higher than 0. If this p-value is lower than 0.05, we report "Yes" in the *Convergence* line. The steady-state prevalence rate is [1/(1+exp(intercept/slope)] in the model with logistic transformation. P-value (H_0: prevalence $\geq PR_{US16}$) is related to the null hypothesis that the long-run prevalence rate is greater than or equal to the 2016 prevalence rate of the US (0.65 for females and 0.75 for males). The EU sample comprises 28 economies: Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, and the United Kingdom.

Table 8: Convergence and Long-run Prevalence Rates — EU and Non-EU samples
Dependent Variable: Annual Change in (Transformed) Obesity Prevalence Rate

	EU sample		**Non-EU sample**		**EU sample**		**Non-EU sample**	
	Female (1)	**Male (2)**	**Female (3)**	**Male (4)**	**Female (5)**	**Male (6)**	**Female (7)**	**Male (8)**
Constant	-0.015***	-0.019***	0.008***	0.017***	0.001*	0.001***	-0.003	0.002
	(0.0014)	(0.0029)	(0.0014)	(0.0028)	(0.0004)	(0.0002)	(0.0030)	(0.0012)
Lagged transformed prevalence rate	-0.0164***	-0.0208***	-0.0030***	-0.0053***	0.0072***	0.0345***	0.0299***	0.0952***
	(0.0007)	(0.0012)	(0.0008)	(0.0010)	(0.0006)	(0.0008)	(0.0009)	(0.0010)
No. of countries	28	28	17	17	28	28	17	17
No. of periods	42	42	42	42	42	42	42	42
No. of observations	1176	1176	714	714	1176	1176	714	714
Control variables	No	No	No	No	No	No	No	No
Logistic transformation	Yes	Yes	Yes	Yes	No	No	No	No
Convergence	Yes	Yes	Yes	Yes	No	No	No	No
Steady-state prevalence rate	0.284	0.288	0.925	0.964	...	...	...	...
95% confidence interval	[0.269 0.308]	[0.283 0.379]	[0.751 0.999]	[0.854 1.000]	...	...	...	...
P-value (H_0: no convergence)	0.000	0.000	0.000	0.000	0.991	0.999	0.897	1.00
P-value (H_0: prevalence ≥ 0.5)	0.000	0.000	1.000	1.000	...	...	...	...

Notes: * p-value < 0.1, ** p-value < 0.05, *** p-value < 0.01. All the models use logistic-transformed prevalence rates. We use a bias-corrected fixed effects estimator (Kiviet, 1995; Bruno, 2005). Models include fixed country effects and a common trend component (log-linear trend). P-values, standard errors (in parentheses), and confidence intervals are calculated using 2000 bootstrap replications. P-value (H_0: no convergence) is related to the null hypothesis that the slope of the lagged transformed prevalence is equal to or higher than 0. If this p-value is lower than 0.05, we report "Yes" in the *Convergence* line. The steady-state prevalence rate is [1/(1+exp(intercept/slope)] in the model with logistic transformation. P-value (H_0: prevalence $\geq$ 0.5) is related to the null hypothesis that the steady-state prevalence rate is equal to or higher than 0.5. The EU sample comprises 28 economies: Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, and the United Kingdom.