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# Health differentials between citizens and immigrants in Europe: A heterogeneous convergence

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## Ethics approval

Our study is based on data from SHARE Waves 1, 2, 3 (SHARELIFE), 4 and 5 (DOIs: 10.6103/SHARE.w1.500, 10.6103/SHARE.w2.500, 10.6103/SHARE.w3.500, 10.6103/SHARE.w4.500, 10.6103/SHARE.w5.500). The SHARE study is subject to continuous ethics review. During Waves 1 to 4, SHARE was reviewed and approved by the Ethics Committee of the University of Mannheim. Wave 4 of SHARE and the continuation of the project were reviewed and approved by the Ethics Council of the Max Planck Society.

**Highlights:**

- We investigate differences in health patterns between immigrants and citizens in Europe.
- We use panel data on more than 100,000 older adults.
- Results show a reversal of health differentials between citizens and immigrants.
- There is also substantial heterogeneity across immigrant groups.
- The importance is stressed on the wealth of the country of origin.

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4 **Health differentials between citizens and immigrants in Europe:**  
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6 **A heterogeneous convergence**  
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11 **Abstract**  
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14 The literature on immigration and health has provided mixed evidence on  
15 the health differentials between immigrants and citizens, while a growing body  
16 of evidence alludes to the unhealthy assimilation of immigrants. Relying on  
17 five different health measures, the present paper investigates the heterogeneity  
18 in health patterns between immigrants and citizens, and also between immi-  
19 grants depending on their country of origin. We use panel data on more than  
20 100,000 older adults living in nineteen European countries. Our panel data  
21 methodology allows for unobserved heterogeneity. We document the existence  
22 of a healthy immigrant effect, of an unhealthy convergence, and of a rever-  
23 sal of the health differentials between citizens and immigrants over time. We  
24 are able to estimate the time threshold after which immigrants' health be-  
25 comes worse than that of citizens. We further document some heterogeneity  
26 in the convergence of health differentials between immigrants and citizens in  
27 Europe. Namely, the unhealthy convergence is more pronounced in terms of  
28 chronic conditions for immigrants from low-HDI countries, and in terms of  
29 self-assessed health and body-mass index for immigrants from medium- and  
30 high-HDI countries.  
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50 **Keywords:** Healthy immigrant effect · Europe · Health differentials · Health  
51 convergence · Immigration · Health economics.  
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54 **JEL classification:** F22 · I14 · J15.  
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4 **1. Introduction**  
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7 The literature on immigration and health has provided mixed evidence on the  
8 health differentials between citizens and immigrants in developed countries. While  
9 some studies report that immigrants are in better health than citizens [1, 2, 3, 4, 5] -  
10 providing support for the so-called *healthy immigrant effect* - others find the opposite  
11 [6, 7]. A growing body of evidence further shows that immigrants' health deteriorates  
12 with the length of residence in the host country [8, 9, 10, 11]. This phenomenon,  
13 sometimes called *unhealthy assimilation*, implies that the healthy immigrant effect,  
14 if any, is transitory. Describing and explaining the evolution of immigrants' health is  
15 of particular importance from a research and policy perspective. Once settled in the  
16 host country, immigrants would tend to have different health trajectories, not only  
17 relative to their native counterparts, but also among subgroups of immigrants.  
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30 The present paper attempts to assess whether the healthy immigrant effect, if  
31 any, is followed by a convergence of immigrants' health status toward that of citizens  
32 in Europe. We use panel data on more than 100,000 older adults living in nineteen  
33 European countries. The panel data methodology employed allows for unobserved  
34 heterogeneity. We document the existence of a healthy immigrant effect, of an un-  
35 healthy convergence, and of a reversal of the health differentials between citizens and  
36 immigrants over time. We are able to estimate the time threshold after which immi-  
37 grant's health becomes worse than that of citizens. We further show that the effect  
38 on health of the immigrants' length of residence in the host country differs depending  
39 on the wealth of the country of origin and on the health measure considered. The  
40 present paper fits in the literature investigating the heterogeneity in health patterns  
41 across immigrant groups, with a focus on the wealth of the immigrants' country  
42 of origin. Once settled in the European countries, immigrants from poor countries  
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4 tend to work in the so-called 3D jobs (dirty, dangerous and demeaning) [12]. In this  
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6 regard, the positive health selection (the healthy immigrant effect) would be higher  
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8 for immigrants from poorer countries because of the physically demanding nature of  
9  
10 their work [13]. This would also be a factor of faster health deterioration.  
11

12 As we investigate the effect on health of the immigrants' length of stay in Europe,  
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14 we focus on older immigrants. In North-West European countries, the three decades  
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16 after 1945 were characterized by large-scale labour immigration. Immigration into  
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18 southern European destinations became significant from the 1970s [14]. We are  
19  
20 now able to investigate the evolution of immigrants' health over a long time span,  
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22 which explains the recent development of studies on older immigrants in Europe  
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24 [14, 8, 9, 7, 15].  
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27 The remaining of the paper is organized as follows. Section 2 reviews the liter-  
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29 ature on immigrants' health in developed countries. The data and the econometric  
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31 methodology are detailed in Sections 3 and 4, respectively. Section 5 presents the  
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33 results, and Section 6 discusses the implications of the findings and concludes.  
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## 36 **2. Literature review: immigrant's health in developed countries**

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40 In developed countries, health differentials between natives and immigrants and  
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42 their evolution have been linked to the interplay of several factors. These include  
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44 socio-economic conditions, individual factors (immigrants' behavior, health-related  
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46 selection), and characteristics of both the country of origin (social norms, wealth)  
47  
48 and of destination (social norms, integration policies towards immigrants). These  
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50 health differentials are often mirrored by differences in access to health care.  
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53 McDonald and Kennedy [1] document a healthy immigrant effect and an un-  
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55 healthy convergence in Canada regarding chronic conditions, but not self-assessed  
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4 health, indicating that this phenomenon would be more pronounced in terms of  
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6 physical health than health perceptions. Also in Canada, while showing the exist-  
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8 tence of a healthy immigrant effect in the case of depression, Wu and Schimmele [2]  
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10 find that depression among immigrants increases with their length of stay.  
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12 In the United States, immigrants are less likely to have health insurance coverage  
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14 and have lower health care use and spending than their native counterparts [16, 17,  
15  
16 18, 19, 20]. Observed differences in the access to health insurance and health care  
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18 have been seen as one of the interplaying factors behind citizen-immigrant health  
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20 differentials. Antecol and Bedard [3] show that immigrants have a lower body-  
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22 mass index (BMI) upon arrival, but that they converge to that of the Americans  
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24 as the length of stay increases. This relationship between BMI and duration of  
25  
26 residence varies by gender and ethnicity [21], and by arrival cohorts, with more recent  
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28 immigrant cohorts being more likely to be obese upon arrival and to experience  
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30 a faster unhealthy convergence [22]. Other recent studies show that social norms  
31  
32 in both the host country and the country of origin influence immigrants' health  
33  
34 behaviors. Focusing on smoking behaviors, Leung [23] finds that assimilation in  
35  
36 the United States is positively (negatively) associated with the likelihood of being a  
37  
38 smoker for immigrants from low-smoking (high-smoking) countries.  
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41 Analyses of the relationship between immigrants' health and duration of residence  
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43 in Europe have yielded mixed and sometimes conflicting evidence. Lindert et al. [24]  
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45 report disparities across migrant groups in the prevalence of mental disorders and in  
46  
47 the access and utilization of mental health services. Solé-Auró et al. [7] investigate the  
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49 differences in health care utilization between older natives and immigrants. They find  
50  
51 that older immigrants, particularly those who arrived recently, have a higher use of  
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53 health care services (physician visits and hospital stays), due to differences in health,  
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55 health behaviors, socio-economic status or countries' health system characteristics.  
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4 Moullan and Jusot [25] show the existence of a North-South gradient in immigrants'  
5 health status, with immigrants in Italy and Spain having a better health status than  
6 in Belgium and France. Using three different health measures (self-reported health  
7 status, limiting long-standing illnesses, and self-reported chronic illness), Giannoni  
8 et al. [5] show that non-European immigrants tend to have better health in countries  
9 with pro-immigrant integration policies.

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16 Using Swedish data, Pudaric et al. [26] show that, compared with Swedish-born  
17 individuals, country of birth is associated with poor health status (for immigrants  
18 from Southern Europe, Eastern Europe and Finland) and impaired instrumental ac-  
19 tivities of daily living (for Southern Europeans, Finns and refugees from developing  
20 countries). The authors also provide a theoretical framework for the link between  
21 immigrants' health deterioration and acculturation. They argue that poorly ac-  
22 culturated immigrants are exposed to long-term stress reactions due to a series of  
23 individual, structural and cultural factors, which may in turn harm their health.  
24 Bengtsson and Scott [27] highlight a gap in sickness benefit consumption between  
25 Swedish natives and immigrants, and also between immigrants depending on the  
26 country of birth. The authors show that while western immigrants and natives dis-  
27 play similar patterns, immigrants from labor-sending countries, whose occupations  
28 are more physically demanding, have a higher average number of sick days.  
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44 In Spain, Malmusi et al. [8] document large migration-related health inequalities,  
45 with immigrants from poor areas being the worse-off group, which can be related  
46 to immigrants' socio-economic deprivation compared with natives. Evidence that  
47 immigrants' health deteriorates over time at a faster rate for immigrants working in  
48 high-risk jobs have been found in Spain [28] and in Germany [11].  
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54 In France, Vignier et al. [29] report that individuals in threat-related exile have  
55 a lower probability of accessing health care. Furthermore, it has been shown that  
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4 undocumented immigrants experience great difficulty in exercising their rights to  
5 health care and tend to underutilize the *State Medical Assistance* [30]. The settlement  
6 process of recently arrived immigrants from sub-Saharan Africa has been shown to  
7 be long and precarious [31]. This long period of insecurity is mirrored by a lower  
8 health care utilization of recently arrived immigrants compared to the French-born  
9 population with equivalent health needs. This is reported in Berchet and Jusot  
10 [32], who also indicate that the healthy immigrant effect was mainly observed for  
11 immigrants who settled in France before the economic crisis of the mid-1970s. And  
12 even for these first- and second-generations immigrants, studies show that they suffer  
13 from premature dependency in old age [33], and, more generally, that their health  
14 became worse than that of the French-born population from the mid-2000s [34, 35].  
15 Such health disparities are mainly due to differences in social capital, income and  
16 occupation status [36], and vary depending on the region of origin [37].  
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### 32 **3. Data**

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36 We use data from the SHARE survey [38], which primarily aims at investigat-  
37 ing ageing issues in Europe. The SHARE survey has also been used to investigate  
38 the relationship between immigration and health [9, 7, 15]. Our analysis is based  
39 on four waves conducted in 2004-2005, 2006-2007, 2010-2012 and 2013, respectively.  
40 These waves share the same methodology. The survey samples individuals over 50  
41 years old in European countries. Individuals of the same household are also sur-  
42 veyed, regardless of their age. The 19 countries in the sample are Austria, Belgium,  
43 Czech Republic, Denmark, Estonia, France, Germany, Greece, Hungary, Ireland,  
44 Italy, Luxembourg, the Netherlands, Poland, Portugal, Slovenia, Spain, Sweden,  
45 and Switzerland.  
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4 Individuals' citizenship status (citizen or immigrant) is the main variable of in-  
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6 terest. Among the alternative definitions of "immigrant", that are based on country  
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8 of birth, nationality or length of stay in the host country [39], we have opted for the  
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10 definition based on nationality, as the focus is on individuals who are legal residents,  
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12 either permanent, temporary or refugees, and who represent a distinct category of  
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14 the population. A study including three different categories - immigrants born for-  
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16 eigners in a foreign country, naturalized citizens and native citizens - would have  
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18 been of great interest, but we cannot identify naturalized citizens in our data.  
19

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21 When individuals are surveyed for the first time, major life events are collected  
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23 retrospectively. Thus, we know the immigrants' year of arrival, allowing us to com-  
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25 pute the length of stay in the host country. As it is likely to be highly correlated  
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27 with age, we divide the length of stay by the age. This measures the immigrants'  
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29 share of lifetime in the host country. Immigrants in the sample arrived in the host  
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31 country between 1916 and 2013. Immigrants' year of arrival distribution is shown in  
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33 Figure 1.  
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35  
36 *[Figure 1 about here]*  
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40 We also have information on the immigrants' country of origin, from which we  
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42 construct a categorical variable based on the wealth of the country of origin. We  
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44 use the UN's Human Development Index (HDI) as a measure of wealth. The HDI  
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46 index doesn't measure economic growth alone but also considers individuals and their  
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48 capabilities. GDP is a particular measure of wealth focusing only on this part of  
49  
50 wealth which is measurable by a monetary value. By using HDI we intend to move  
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52 beyond GDP and account a broader societal dimension of wealth and well-being.  
53  
54 Based on their HDI value in 2015, countries of origin are classified as low human  
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56 development ( $\text{HDI} < 0.700$ ), medium ( $0.700 \geq \text{HDI} < 0.836$ ) and high human  
57  
58 development ( $\text{HDI} \geq 0.836$ ).  
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4 development (HDI  $\geq$  0.836). The 0.700 cut-off is commonly used to distinguish  
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6 low- from medium-HDI countries, and the 0.836 cut-off represents the lowest HDI  
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8 value among European Union countries (Hungary), as performed by Malmusi et al.  
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10 [8]. Although immigrants in the sample arrived in the host country between 1916  
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12 and 2013, we only use the 2015 HDI of the country of origin, as more than 83%  
13  
14 of the immigrants left their country of origin before the oldest year for which HDI  
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16 data is available. The wealth of the country of origin should be interpreted with an  
17  
18 appropriate degree of caution related to the fact that, although HDI data exhibit a  
19  
20 strong path-dependency, some countries may be categorized in a given HDI category  
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22 which was not the same at the time of migration.  
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25 Detailed definitions of the variables used are given in Table 1. Five different health  
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27 measures are used as dependent variables: (1) SAH (whether the individual reports a  
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29 less than very good health), as is common in the literature (see for instance Antecol  
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31 and Bedard 3 or Malmusi et al. 8), (2) the body-mass index (whether the individual  
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33 is overweight or obese), (3) chronic conditions (the number of chronic diseases), (4)  
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35 mental health (whether the individual is depressed), and (5) physical limitations  
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37 (whether the individual has one or more limitations with activities of daily living  
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39 [ADL]). An extended discussion on the relevance of the health measures considered  
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41 is provided in Appendix A1 of the electronic supplementary material. Descriptive  
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43 statistics of the variables used in the analyses are given in Table A1 of the electronic  
44  
45 supplementary material. Individuals in the sample are aged 22 to 103. Citizens'  
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47 and immigrants' age distributions are relatively similar, as shown in Table A2 of  
48  
49 the electronic supplementary material. Table A3 of the electronic supplementary  
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51 material displays the percentage of immigrants by region of origin. The majority of  
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53 immigrants come from the European Union or other European countries (48.09% and  
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55 30.48%, respectively). Stateless persons represent 8.07% of the sample of immigrants,  
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4 and immigrants coming from Africa represent 7.74%. Immigrants from the Americas  
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6 or Asia and Oceania represent slightly less than 3%, respectively.  
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9 *[Table 1 about here]*  
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#### 11 12 13 **4. Econometric methodology** 14

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16 We use a Mundlak [40] panel probit model for all binary dependent variables  
17 (Equation 1), and a Mundlak [40] panel Poisson model for the discrete positive de-  
18 pendent variable, that is, the number of chronic diseases (Equation 2). The Mundlak  
19 [40] specification is a fixed effect for all time-varying variables and a random effect  
20 for all time-constant variables. With a usual fixed effect model we would not be able  
21 to estimate a parameter for time-constant variables. With a random specification  
22 we would impose a certain specification to time-varying and time-constant variables.  
23 The Mundlak specification allows us to take the best of the two specification by  
24 transforming a random effect statistical routine in a fixed effect model for the time-  
25 varying variables if and only if the intra individuals means of these variables are  
26 included [41]. For individual  $i$  ( $i = 1, \dots, n$ ) in survey year  $t$  ( $t = 1, \dots, T$ ):  
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$$42 \quad P(y_{it} = 1|x_{it}) = \Phi(x_{it}\beta + c_i) \quad (1)$$

43  
44 where  $\Phi$  is the standard normal cumulative distribution function.  
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$$48 \quad P(Y_{it} = y_{it}|x_{it}) = F(y_{it}, x_{it}\beta + c_i) \quad (2)$$

49  
50 where  $F(x, z) = P(X = x)$ .  $X$  is Poisson distributed with mean  $\exp(z)$ .  
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52

53 Equation 1 and Equation 2 are estimated using maximum likelihood. In both  
54 models,  $x_{it}$  is the vector of explanatory variables (some of these variables are con-  
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stant over time) and  $c_i$  is the time-invariant unobservable. We include the within-individual means of the time-varying regressors,  $\bar{x}_i$ , to allow for the possibility that the unobserved time-invariant individual effect and the regressors are correlated (see Wooldridge 42 for further methodological details):

$$c_i = \bar{x}_i\theta + \nu_i \quad \text{and} \quad E(c_i|x_i) = \bar{x}_i\theta \quad (3)$$

where  $\bar{x}_i$  is the panel-level mean of  $x_{it}$ , and  $\nu_i$  is a time-invariant unobservable that is uncorrelated to the regressors.

We include both age and period (survey wave) effects in the model. Cohort effects are not included due to the age-period-cohort identification problem and the impossibility to disentangle these three effects, as they are mathematically confounded [43]. Period effects are likely to capture unobserved factors common to all individuals in the sample. Country fixed effects are also included in the model to control for unobserved country-specific characteristics. Robust standard errors are computed at the household level to account for intra-household correlation. By using the Mundlak specification, the model accounts for the correlation between time-varying regressors and individual effects. We nonetheless acknowledge the potential presence of time-varying sources of endogeneity (for instance an income shock affecting both the access to health care and health outcomes).

Finally, we calculate average partial effects (APEs) to discuss the results in terms of magnitude. APEs are computed by averaging the partial effects across the population distribution of individual effects, which integrates out the unobserved heterogeneity [42].

As we focus on older immigrants, we cannot rule out the potential presence of a so-called *salmon bias* in our analysis. The literature on the salmon bias - immigrants

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4 who suffer from a long-term illness returning to their country of origin - has recently  
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6 been reviewed in a study by Wallace and Kulu [44], reporting mixed evidence. More  
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8 importantly, when there is evidence of a salmon bias, studies show that the mortality  
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10 of those who return to their country of origin should have been unrealistically high  
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12 in order to offset the migrant mortality advantage [45, 44]. From an econometric  
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14 standpoint, the salmon bias would imply that there is measurement error in the  
15  
16 dependent variable due to the fact that health of some immigrants would not be  
17  
18 accounted for. The measurement error would thus be positively associated with the  
19  
20 dummy variable for being an immigrant. In a similar manner, the immigrants' length  
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22 of stay in the host country would be positively associated with the measurement error,  
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24 in the sense that the parameter on length of stay would have been larger without  
25  
26 the presence of a salmon bias, if any.  
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## 30 **5. Results**

### 31 32 33 **5.1 Baseline model**

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37 Maximum likelihood estimates of the model (Equation 1 and Equation 2) and  
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39 APEs are reported in Table A4 of the electronic supplementary material. The es-  
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41 timates show that immigrants are more likely to be in better health than citizens.  
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43 This is true for all dependent variables except mental health, for which there is no  
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45 significant difference between citizens and immigrants. The APE of being an im-  
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47 migrant ranges from -0.029 (for ADL limitations) to -0.067 (for chronic conditions).  
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49 The probability of reporting poor SAH is 4.2%-points lower for immigrants than for  
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51 citizens. As reported in the introduction, such healthy immigrant effect has been  
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53 highlighted previously. Nevertheless, the results reveal that the immigrants' length  
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55 of stay - measured as the share of lifetime in the host country - is significantly and  
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4 negatively associated with their health for all five health measures. A 10% increase  
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6 in the share of lifetime in the host country increases the probability of reporting poor  
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8 SAH by 1.13%-points. Immigrants who spent most of their lives in the host country  
9  
10 have a 11.3% higher probability of reporting poor health than those who arrived  
11  
12 very recently. This is illustrated in Figure 2, which shows the estimated relation-  
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14 ship between the immigrants' length of stay and their health for the five dependent  
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16 variables.  
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20 *[Figure 2 about here]*  
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23 The estimated health of citizens is included for comparison. We can see that the  
24  
25 healthy immigrant effect holds only for immigrants who arrived recently in the host  
26  
27 country. For all five health measures, health worsens with the share of lifetime in  
28  
29 the host country. Another important result is that, when the share of lifetime in  
30  
31 the host country increases, immigrants' health eventually becomes poorer than that  
32  
33 of citizens, as illustrated in Figure 2. Immigrants' self assessed and mental health  
34  
35 reach the level of citizens when they have spent around 30 to 35% of their life in the  
36  
37 host country (corresponding to, on average, approximately 18 to 21 years spent in  
38  
39 the host country). For obesity and overweight, immigrants reach the level of citizens  
40  
41 after having spent 45% of their life in the host country (on average approximately  
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43 27 years). This figure rises to 50% for chronic conditions (on average approximately  
44  
45 30 years) and 80% for ADL limitations (on average approximately 52 years).  
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48 We now interpret the coefficients for the other variables, which are common to  
49  
50 all individuals in the sample. Compared to men, women are less likely to report  
51  
52 poor health, to be overweight or obese, or to have physical limitations, but are  
53  
54 more likely to have poor mental health. No significant gender difference is found  
55  
56 for chronic conditions. Formal education is negatively associated with poor health  
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4 status, with evidence of an education gradient. Current job situation is found to have  
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6 different effects depending on the health measure considered. Note that the variable  
7  
8 on current job situation has a specific category for permanently sick individuals,  
9  
10 because their job situation is necessarily determined by their condition. This allows  
11  
12 to appropriately capture the effect of being unemployed. In the case of SAH and  
13  
14 mental health, being retired is associated with better health compared to all other  
15  
16 categories (employed or self-employed, unemployed and homemaker or permanently  
17  
18 sick). Being employed or self employed is associated with better health compared  
19  
20 to all other categories in the case of BMI and chronic conditions. Regarding ADL  
21  
22 limitations, being unemployed, homemaker or permanently sick is associated with  
23  
24 poor health, while no significant association is found for the other categories. Marital  
25  
26 status is found to have no effect on chronic conditions and ADL limitations. The  
27  
28 likelihood of having poor mental health is 9%-points higher for widowed than for  
29  
30 individuals who are married or in a registered partnership (the reference category),  
31  
32 while no significant association is found for the other categories (never married and  
33  
34 divorced). Being divorced is positively associated with being overweight or obese.  
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36 Never married and widowed individuals are more likely to have poor SAH. Drinking  
37  
38 is positively associated with being overweight or obese, negatively associated with  
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40 having poor mental health, and has no significant association with SAH, chronic  
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42 conditions and ADL limitations. Physical inactivity increases the probability of  
43  
44 having poor health for all health measures except BMI, for which it is negatively  
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46 associated with being overweight or obese. Having children is associated with better  
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48 mental and SAH, fewer chronic conditions, a higher likelihood of being overweight or  
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50 obese and appears to be not associated with ADL limitations. Having grandchildren  
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52 is associated with a higher likelihood of being overweight or obese, more chronic  
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54 conditions, poor SAH (for three grandchildren or more) and is not associated with  
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4 mental health and ADL limitations. For all health measures except BMI, the number  
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6 of medical consultations is strongly associated with poor health, with a marked  
7  
8 gradient. In the same way, the number of nights in hospital is linearly associated  
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10 with poor health except for BMI, for which individuals who spent six or more nights  
11  
12 in hospital in the year preceding the survey are less likely to be overweight or obese.  
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14 Households' ability to make ends meet is associated with a higher likelihood of being  
15  
16 overweight or obese. For all other health measures, the ability to make ends meet  
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18 is associated with better health, with evidence of a socio-economic gradient in the  
19  
20 case of self-assessed and mental health. The analysis of period (survey wave) effects  
21  
22 indicates that the likelihood of being overweight or obese, of developing chronic  
23  
24 diseases and of having poor mental health increased over time (from 2004-2005 to  
25  
26 2013). Almost no significant period effects are found for self-assessed health and  
27  
28 ADL limitations. Finally, age is positively associated with poor health in the case  
29  
30 of SAH and ADL limitations, and negatively associated with poor health in the  
31  
32 case of BMI, chronic conditions and mental health. The unexpected negative effect  
33  
34 of age for chronic conditions and mental health might due to the fact that, for an  
35  
36 undocumented reason, the average number of chronic conditions and mental health  
37  
38 are slightly decreasing between each individual's first and second interview (which  
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40 may be distinct from the first and second wave, as some individuals entered the  
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42 SHARE survey after the first survey-wave).  
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## 47 **5.2. Wealth of the country of origin**

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51 To gain more understanding about the effects of being immigrant on health, we  
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53 also investigate whether the effects highlighted previously change depending on the  
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55 wealth of the country of origin. To do so, the immigrant status variable of the  
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4 previous model is allowed to take on several values based on the level of human  
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6 development of the country of origin. This variable is also interacted with the im-  
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8 migrants' share of lifetime in the host country. Maximum likelihood estimates and  
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10 APEs are presented in Table A5 of the electronic supplementary material. Note  
11  
12 that all the other results remain qualitatively the same, in terms of sign, magnitude,  
13  
14 and statistical significance. Figure 3 shows the estimated relationship between the  
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16 immigrants' length of stay and their probability of having poor health depending on  
17  
18 the wealth of the country of origin. This is done for the five health measures.  
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22 *[Figure 3 about here]*  
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25 The results reveal that the effect of being an immigrant on health, and also that  
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27 of the length of stay in the host country, varies depending on the wealth of the coun-  
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29 try of origin and the health measure considered. When arriving in the host country,  
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31 immigrants from high HDI-countries are less likely to have poor SAH than citizens,  
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33 while no significant association is found for the other categories. Nevertheless, when  
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35 the share of lifetime in the host country increases, immigrants from medium- and  
36  
37 high-HDI countries have poorer SAH, as illustrated in Figure 3a. The length of stay  
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39 does not appear to change the SAH of stateless persons or immigrants from low-HDI  
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41 countries. In the case of BMI, we found previously that immigrants are less likely  
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43 to be overweight or obese than natives, but that this likelihood increases with the  
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45 share of lifetime in the country. This result seems to hold mainly for immigrants  
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47 from high-HDI countries. Although their likelihood of being overweight or obese is  
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49 10.3%-points lower than that of citizens, immigrants from high-HDI countries who  
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51 spent most of their lives in the host country are 21.4% more likely to be overweight  
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53 or obese than those who arrived very recently, as shown in Figure 3b. The results  
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55 regarding chronic conditions reveal a marked socio-economic gradient in the effect  
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4 of being an immigrant and in that of their length of stay in the host country. Im-  
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6 migrants have a lower likelihood of developing chronic diseases, as shown previously.  
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8 Compared to citizens, the likelihood of developing a chronic disease is 20.1%-points  
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10 lower for immigrants from low-HDI countries, while this figure falls to 8.4% and 3%  
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12 for immigrants from medium- and high-HDI countries, respectively. We showed ear-  
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14 lier that, among immigrant, the likelihood of developing chronic diseases increases  
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16 with the share of lifetime in the country. We now show that, although immigrants  
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18 from low-HDI countries have the lowest likelihood of having chronic conditions, they  
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20 have the highest rate of health deterioration. There is a 28.2% difference between  
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22 immigrants from low-HDI countries who arrived very recently and those who spent  
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24 most of their lives in the host country. This figure falls to 14.4% and 7.7% for immi-  
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26 grants from medium- and high-HDI countries, respectively. The poorer the country  
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28 of origin, the higher the deterioration of health with increasing share of lifetime in  
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30 the host country. This is illustrated in Figure 3c. In the case of mental health, it  
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32 seems that stateless persons have a lower likelihood of being depressed, while no  
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34 significant association is found for the other groups. The results also indicate that  
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36 immigrants from medium-HDI countries and stateless persons experience a mental  
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38 health deterioration with the length of stay in the host country. Finally, the results  
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40 show that the results found previously regarding ADL limitations hold mainly for  
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42 immigrants from medium-HDI countries. They have a lower likelihood of having one  
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44 or more ADL limitations, but this likelihood increases with the length of stay in the  
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46 host country.  
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## 51 **6. Conclusion**

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55 The question of whether there are significant health differentials between citizens  
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4 and immigrants has extensively been addressed in the literature. Nonetheless, less is  
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6 known about the evolution of immigrants' health over time. This paper attempted  
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8 therefore to explore the dynamics of citizen-immigrant health differentials as well  
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10 as the determinants of these dynamics. It employed panel models that allow for  
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12 unobserved heterogeneity amongst more than 100,000 older persons living in nine-  
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14 teen European countries. Unlike previous studies that only focused on one or two  
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16 measures of health, the present analysis has considered five different indicators of  
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18 health status. This allowed to account for the multidimensionality of health and its  
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20 evolution over time. Assessing the impact of the length of stay on immigrant health  
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22 requires adjusting for the effect of age. The latter has been accounted for by using  
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24 an age-adjusted measure of the length of stay in the host country.  
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27 Our paper highlighted large health differentials (1) between citizens and immi-  
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29 grants, (2) between immigrants depending on their length of stay in the host country,  
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31 and (3) between immigrants depending on the wealth of their country of origin. These  
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33 differentials are found to vary depending on the health measure considered. Some  
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35 interesting results emerging from our analysis are worth discussing. First, our study  
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37 generally, corroborates previous evidence on the healthy immigrant effect – according  
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39 to which immigrants are initially more likely to be in better health as compared to  
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41 citizens [1, 2, 3, 4, 5]. Secondly, our study also corroborates previous findings on the  
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43 unhealthy assimilation of immigrants in developed countries [8, 9, 10, 11]. For all  
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45 health measures considered, we found that, on average, immigrants' health deterio-  
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47 rates over time. In contrast to previous studies, our results not only shed light on  
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49 the convergence of immigrants' health towards that of citizens. Interestingly, using  
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51 an age-adjusted measure of the length of stay in the host country, we were able to  
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53 show that this unhealthy convergence is such that the health of immigrants eventu-  
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55 ally becomes poorer than that of citizens. Thirdly, our results clearly revealed the  
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4 presence of substantial heterogeneity in the observed unhealthy convergence, with  
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6 respect to both the wealth of the country of origin and the health measured con-  
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8 sidered. For instance, in terms of chronic conditions, the health of immigrants from  
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10 low-HDI countries tends to deteriorate faster than that of immigrants from richer  
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12 countries. This is not surprising given that immigrants from low-HDI countries tend  
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14 to work in the so-called 3D jobs (dirty, dangerous and demeaning) once settled in  
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16 the European countries [12]. By contrast, the unhealthy convergence with respect  
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18 to SAH seems to hold mainly for immigrants from medium- and high-HDI coun-  
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20 tries. In this case, the convergence of SAH towards that of citizens may well be a  
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22 result of peer effects. Self-assessments of health have been shown to be influenced  
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24 by social comparisons within age groups, especially among older people [46]. Thus,  
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26 immigrants from medium- and high-HDI countries may tend to rate their health as  
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28 similar to that of their native peers, which are more likely to belong to the same  
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30 socio-economic group.  
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33 Altogether, such heterogeneity in the convergence of health differentials between  
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35 immigrants and citizens in Europe seems to indicate that the unhealthy convergence  
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37 is more pronounced in terms of chronic conditions for immigrants from low-HDI  
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39 countries, and in terms of SAH and BMI for immigrants from medium- and high-  
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41 HDI countries. Future research shall attempt to identify the underlying factors of  
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43 such heterogeneous convergence.  
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**Table 1:** Definitions of the dependent and independent variables

| Variable   | Type        | Definition   |
|--|-------------|--|
| <b>Health measures (dependent variables)</b>             |             |  |
| Self-assessed health                                     | Binary      | 1 if the individual $i$ reports a less than very good health in survey wave $t$ ; 0 otherwise  |
| BMI  | Binary      | 1 if the individual $i$ is overweight or obese in survey wave $t$ ; 0 otherwise  |
| Chronic conditions                                       | Discrete    | Individual $i$ 's number of chronic diseases in survey wave $t$  |
| Mental health  | Binary      | 1 if the individual $i$ is depressed in survey wave $t$ ; 0 otherwise  |
| ADL limitations  | Binary      | 1 if the individual $i$ has one or more limitations with activities of daily living in survey wave $t$ ; 0 otherwise   |
| <b>Citizenship status</b>                                | Binary      | Citizen (=base category); Immigrant (legal residents, either permanent, temporary or refugee)  |
| <b>Immigrant's share of lifetime in the host country</b> | Continuous  | Immigrant $i$ 's length of stay in the host country divided by his/her age   |
| <b>Wealth of the country of origin</b>                   | Categorical | Citizen (=base category); Low HDI (<0.700); Medium HDI (0.700>=HDI<0.836); High HDI (>=0.836); Stateless   |
| <b>Gender</b>  | Binary      | Male (=base category); Female  |
| <b>Formal education</b>                                  | Categorical | None or Primary (=base category); Secondary; Tertiary  |
| <b>Current job situation</b>                             | Categorical | Retired (=base category); Employed or Self-employed; Unemployed; Homemaker or Permanently sick [in survey wave $t$ ]   |
| <b>Marital status</b>                                    | Categorical | Married or Registered partnership (=base category); Never married; Divorced; Widowed [in survey wave $t$ ]   |
| <b>Drinking</b>  | Binary      | 1 if the individual $i$ was drinking more than 2 glasses of alcohol almost everyday in survey wave $t$ ; 0 otherwise   |
| <b>Physical inactivity</b>                               | Binary      | 1 if the individual $i$ was physically inactive in survey wave $t$ ; 0 otherwise   |
| <b>Number of children</b>                                | Categorical | 0 (=base category); 1; 2; 3 or more [in survey wave $t$ ]  |
| <b>Number of grandchildren</b>                           | Categorical | 0 (=base category); 1; 2; 3 or more [in survey wave $t$ ]  |
| <b>Doctor consultations</b>                              | Categorical | Number of doctor consultations: 1st quartile (=base category); 2nd; 3rd; 4th [in survey wave $t$ ]   |
| <b>Nights in hospital</b>                                | Categorical | 0 (=base category); Between 1 and 5; 6 or more [in survey wave $t$ ]   |
| <b>Household able to make ends meet</b>                  | Categorical | With great difficulty (=base category); With some difficulty; Fairly easily; Easily [in survey wave $t$ ]  |
| <b>Country</b>   | Categorical | Austria (=base category); Belgium; Czech Republic; Denmark; Estonia; France; Germany; Greece; Hungary; Ireland; Italy; Luxembourg; the Netherlands; Poland; Portugal; Slovenia; Spain; Sweden; Switzerland |
| <b>Survey wave</b>                                       | Categorical | 2004-2005 (=base category); 2006-2007; 2010-2012; 2013   |
| <b>Age</b>   | Continuous  | In years   |

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**Figure 1: Immigrants' year of arrival distribution**

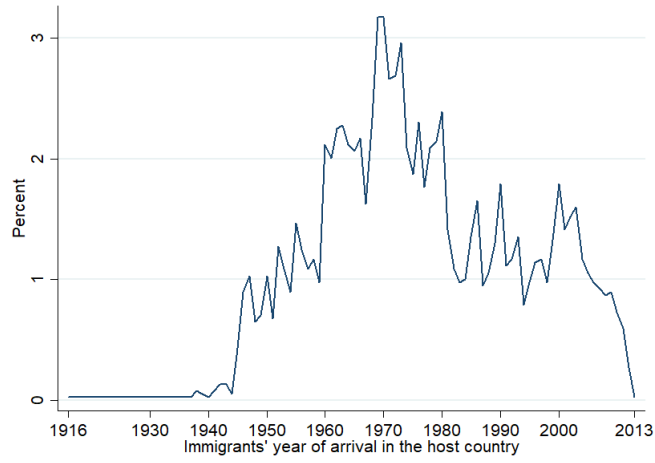
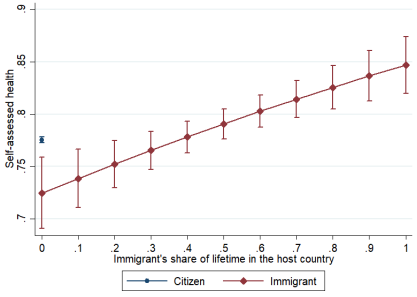
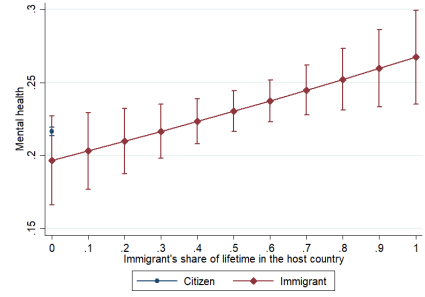


Figure 2: Effect of the immigrants' share of lifetime in the host country on health

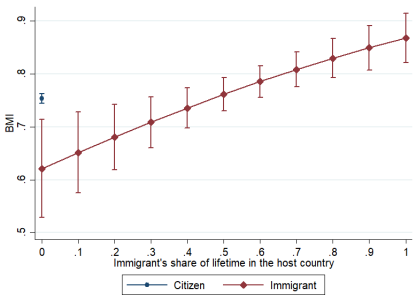
(a) Self-assessed health



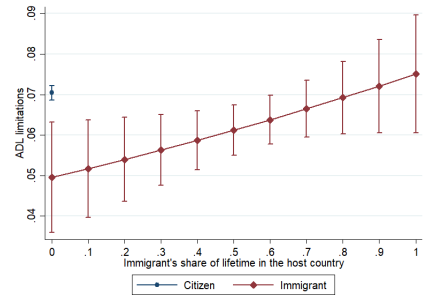
(d) Mental health



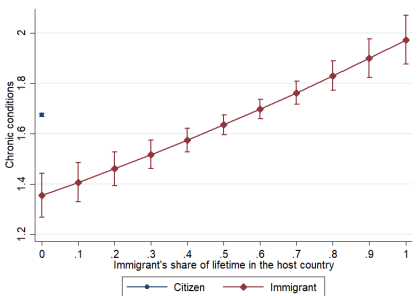
(b) BMI



(e) ADL limitations

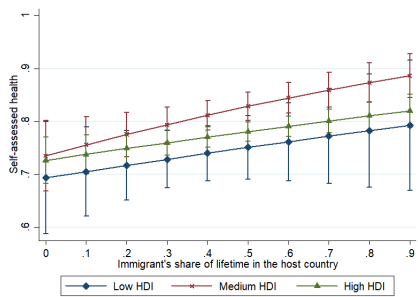


(c) Chronic conditions

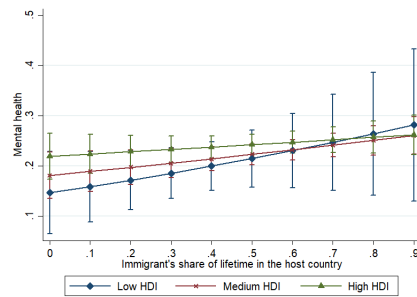


**Figure 3:** Effect of the immigrants' share of lifetime in the host country on health given the wealth of the country of origin

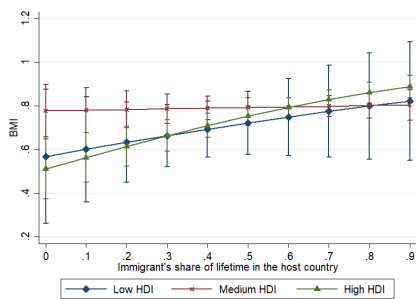
(a) Self-assessed health



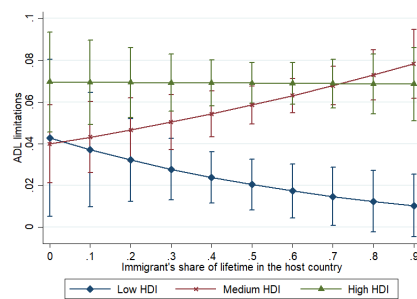
(d) Mental health



(b) BMI



(e) ADL limitations



(c) Chronic conditions

