October 2019
Volume: 16, **No**: 4, pp. 595 – 610
ISSN: 1741-8984
e-ISSN: 1741-8992
www.migrationletters.com

First Submitted: 30 October 2018 Accepted: 18 April 2019

DOI: https://doi.org/10.33182/ml.v16i4.594

The Effect of Health Environment on Migration Flows

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Abstract

International migration has become more popular recently in the globalization context. The recorded number of international migration cases is much fewer than the actual number in the last few decades. Migration is considered to have various consequences in both origin and destination countries. Understanding the determinants of migration is necessary for long-term sustainable development policies. This study examines a causal relationship between health environment and migration flows by exploiting a panel country-level data set on health indicators and net migration from 1940 to 1987. An increase in life expectancy at birth has led to a decrease in net migration in the whole sample countries as well as in non-poor countries. By using global mortality rate constructed based on information on the reduction in mortality following the epidemiological transition in the 1940s as instrumental variable, 2SLS methodology allows controlling for endogeneity problem. The results are robust even applying various additional tests. Overall, health environment has a negative effect on migration flows.

Keywords: *Health environment; migration; instrumental variable; life expectancy at birth.*

Introduction

International migration has become more popular recently in the globalization context. The recorded number of international migration cases is much fewer than the actual number in the last few decades. The 2010 IOM World Migration Report showed that with the same increasing rate as in the last 20 years, the number of international migrants is expected to reach 405 million by 2015 (International Organization of Migration, 2010). There are various reasons to explain for the rapid migration trend, including globalization, easy transportation access, job-seeking, demographic trends, environmental pollution, violence, and human rights abuses.

Previous studies have concentrated mainly on the causes and consequences of migration for both origin and receiving countries (Hatton & Williamson, 2003; Mayda, 2010; Rephann & Vencatasawmy, 2000). Studies have shown that factors, such as age, ethnicity, housing tenure, socio-economic position, and education level, affect the extent to which people migrate (DaVanzo, 1978; Hunt, 2006; Schwartz, 1976; Zhao, 1999) and the distance they migrate (Brimblecombe, Dorling, & Shaw, 1999). Those with higher educational levels and higher socio-economic status tend to migrate further and more often than do those with lower social status and educational levels. Migration has various consequences, like “brain drain” (Docquier & Rapoport, 2012; Dustmann, Fadlon, & Weiss, 2011), lack of childcare in origin countries (Cortes, 2015; Jingzhong & Lu, 2011, Zhou et al., 2015), health and social repercussions (Clark, Stewart, & Clark, 2006; Kingma, 2007), labor supply (Kossoudji, 2015), and economic development in destination countries (Schiff & Ozden, 2007).

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One aspect of migration that has attracted much attention is its impact on public health as well as migrants' health. The migration trend among global health professionals, including nurses, has significant impacts on public health in both origin and destination countries (Kingma, 2007; Clark, Stewart, and Clark, 2006; Oulton, 2006)[2]. The health human resource global migration has been studied through numerous aspects, including brain drain, global care professionals, push-pull.

The reverse impact of health, specifically, the health environment, on migration is still under-researched. Most related studies pay attention to the impact on migration of environment hazards, like earthquakes, hurricanes, nuclear waste facilities, and chemical spills due to the direct connection to environment, which is considered as an important factor of migration. At the individual level, it is suggested that health is directly relevant to migration decisions. On the one hand, those in poor health would be more likely to migrate to seek for better treatment. On the other hand, they also have less ability to move than the good health, especially the elderly, the disabled and the chronic ill (De Haas, 2010; Halliday and Kimmitt, 2008). Sick people also might be less likely to migrate due to financial strains spending in treatment process (Cribier, 1980). Even though the effect of the health environment on migration is still under-researched, there are several studies related to the impact of the quality of life on migration. Hsieh and Liu (1983), Pacheco, Rossouw and Lewer (2013), Liu (1975), and Rebhun and Raveh (2006) explore the relationships between the variations in net migration rates among states and the levels of quality of life measured in those states. Liu (1975)[3] shows that improvement in the quality of life leads to higher net migration rate of all races.

However, those studies ignore endogeneity problems, because areas with expanding provision of public goods and services are typically also areas with expanding economic opportunities. The fact that people migrate to such areas is not conclusive evidence that they are migrating primarily to obtain such goods and services. Moreover, migration in general and immigration, in particular, have impacts on public health as well as migrants' health. There is a correlation between migration and health indicators due to reverse causality. Tackling these endogeneity problems allows us to figure out the causal relationship between the health environment and migration. Such methods as ordinary least squares and Tobit used in previous studies cannot deal with omitted variable bias and reverse causality that arise in most specifications. This study uses a two-stage least squares (2SLS) method to investigate the impact of life expectancy at birth – a proxy for measures of the health environment – on net migration, controlling for endogeneity problems.

I empirically investigate the causal effect of the health environment on migration flows using country-level data[4] for the period 1940 to 1987. In order to account for endogeneity problems and to investigate the causal effect of the health environment (using life expectancy as a proxy) on migration flows (using net migration as proxy), I apply the data and identification strategy suggested

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[2] The trend brings improving health service benefits to developed countries but causes drawbacks by exacerbating the shortage of health service delivery in developing countries, especially in African countries. Migrants might be subjected to multiple forms of discrimination, violence, and exploitation, all of which often directly affect their physical and mental health (Démurger, Gurgand, Li, & Yue, 2009; Zick, Pettigrew, and Wagner, 2008). In addition, migrants might have health problems that are not well known or understood in their new countries of residence.

[3] In addition, Liu (1975) uses a variable of health and welfare provision to investigate the effect on the migration rate of specific factors of quality of life. The estimated result is negative and insignificant. Furthermore, the study investigates the effect of quality of life on internal migration, not international migration.

[4] Population and GDP per capita are taken from Maddison (2003). Net migration rate in 1940 is taken from the UN Demographic Yearbook. Health indicators including life expectancy at birth, infant mortality rate and crude death rate in 1940 are taken from various UN Demographic Yearbook (1948 edition is the key yearbook). Health indicators from 1950 were downloaded from the online UN demographic database. Instead of calculating global mortality rate by myself, I used the data taken from Acemoglu and Johnson (2007) as my instrument variable.

by Acemoglu and Johnson (2007). They use an instrument that exploits within-country reduction in the global mortality rate by the epidemiological transition that took place after 1940, and that was exogenous to a particular country's level of migration flows.

I find that improvements in the health environment cause a decline in net migration. The results still hold when I use different proxies for the health variable, like the crude death rate and infant mortality rate, instead of life expectancy. These findings appear to contradict rational understanding. It is reasonable to expect that improvements in the health environment in one country weaken the motivations of origin residents to emigrate.

The rest of this paper is structured as follows. In the next section, I describe the situation and the trend of migration in the world. Section 2 presents the empirical framework. The main results and robustness check are shown in Section 3. Section 4 presents a discussion and the implications of the results, and Section 5 concludes.

Materials and methods

Migration theory review

Along with the increasing trend of migration, there are various developed migration theories. Considered as the earliest migration theorist, Ernest Ravenstein used census data from England and Wales to develop his "Laws of Migration" (1889). The theory was developed based on "push-pull" process to explain why people migrate from places to places. Push factors include unfavourable factors (high tax, unstable institution, etc.) which encourage people to emigrate. On the other hand, pull factors include favourable ones (high wages, good education, etc.) which encourage people to immigrate. Ravenstein's research is considered as the basement for numerous theorists to develop. In the scope of my research, I will review three remarkable theories which later might somehow explain the migration mechanism discussed in this paper.

First, the neoclassical economic theory (Hicks 1932; Todaro 1969) explains that labour market, more specifically demand and supply of labour, is the driven factor in migration flows. The developed countries with old population tend to have high demand and low supply of labour, which "pull" migration from developing countries with high unemployment rate.

Second, the new economics theory of migration analyzes the migration determinants based on not only individuals but also their families (Stark 1991). Instead of considering the only factor of labour (wages), migrants also put social factors related to their families into consideration. For example, living in a country with low education quality, lacking welfare systems, or instability of institution tend to encourage people to migrate if they have chance and finance.

Last, world-systems theory (Silver 2003) argues that global capitalism has driven international migration flows. Migrants tend to move from periphery – developing countries to the core – developed countries because of industrial development in the First World, which increase the interdependence of economies and production forms.

Migration situation and health environment

Historically, migration in the world has occurred from rural to urban areas, and from small cities to big cities, and has become more popular in the context of globalization as migrants relocate to different countries. In 2015, the number of international migrants worldwide "reached 244 million, an increase of 71 million, or 41%, compared to 2000" (p. 1), according to Trend in International Migrant Stock: The 2015 revision. In addition, the growth of international migrants worldwide has exceeded the world population growth rate. There are various migrant categories, however, most of them are young and at working age.

This study investigates the effect of the health environment on migration flows using data of net migration from 1940 to 1987. Due to the long sample period, the data are limited to 36 base sample countries for the main specification. To obtain a more objective view on the correlation between the health environment and net migration, in this section, I use two country groups: 1) sample data including 36 countries and 2) extensive data including 87 countries. The consideration of representativeness in the database is discussed in relation to sample selection bias in Subsection 3.3.

In this study, I use life expectancy at birth as a proxy for the health environment to investigate the causal effect of the health environment on net migration. Figure 1 below presents the correlation of net migration and life expectancy at birth in different time periods. Figure 1 shows the correlation of the change in net migration and life expectancy at birth in two time periods for sample data (from 1940 to 1987 and from 1940 to 2012)[5] and one time period for extensive data (from 1950 to 1987)[6]. The fitted lines show that an increase in life expectancy is associated with a decline in net migration in both base sample countries and non-poor countries. The fitted lines for the 1940–1987 and 1940–2012 periods have steeper slopes than do the fitted lines for the 1950–1987 period owing to the longer period of time.

Figure 1 highlights that a relationship between the health environment and net migration exists not only in the period 1940–1987, but also more recently. However, the figure shows only a negative association between the health environment and net migration, and not a causal relationship. In the following Section 2, I discuss an empirical strategy to tackle reverse causality and omitted variable bias.

Empirical framework

Estimation framework

The main outcome variable of interest for the empirical investigation is net migration. By definition, "net international migration refers to the difference between the number of immigrants and the number of emigrants. If more people immigrate to a country than emigrate from it, the country gains population from positive net migration. Conversely, when more people emigrate than immigrate, the country loses population through negative net migration" (International Migration Report, 2015, p.27). The main explanatory variable of interest is life expectancy at birth.

Our empirical approach is to estimate the following equation:

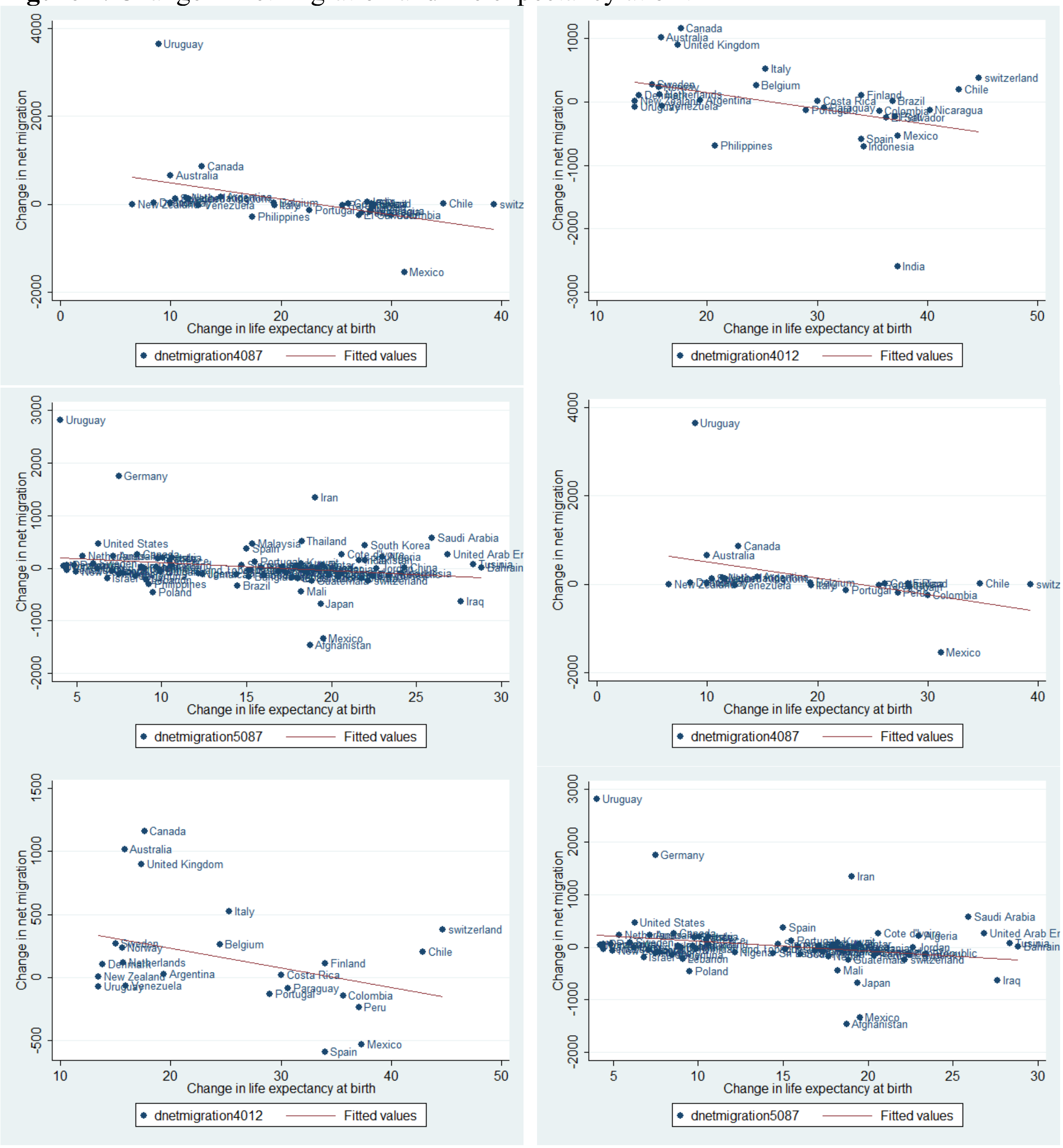
$$y_{it} = \alpha + \beta_1 X_{it} + \beta_2 W_{it} + \mu_i + \nu_t + \varepsilon_{it} \qquad (1)$$

where y_{it} is net migration in country i at year t, X_{it} is life expectancy at birth (the variable of interest), and W_{it} are control variables, including log GDP per capita and population in country i at year t. The country fixed effect μ_i and the time fixed effect ν_t capture time-invariant omitted

[5] Because the research period 1940–1987 is quite far from now, I include the period 1940–2012 to show a similar association between life expectancy and net migration in the two time periods.

[6] The sample size in the study period with 36 countries (1940–1987) is quite small. This might not represent the whole population sample. Therefore, I include extensive data in the time period with 87 countries (1950–1987) to show a similar association between life expectancy and net migration in the two time periods.

Figure 1. Change in net migration and life expectancy at birth



Source: Demographic Year Book 1948–1990, World Bank Databank 1990–2012 and Acemoglu and Johnson (2007)
Notes: The vertical axes represent the change in net migration; the horizontal axes show the change in life expectancy at birth. The figure shows the relationship between change in net migration and life expectancy at birth of two country groups in 1940–1987, 1940–2012, and 1950–1987.

effects within country and time-varying factors common across all countries. The coefficient β_1 is the parameter of interest. Inclusion of country fixed effects is important because there are numerous country-specific factor affecting health and migration outcomes. Including fixed effects is expected to remove the time-invariant components of these factors, such as different in geography and political regime. Economic development is an important factor affecting migration decision making.

The increase in GDP per capita is expected to lower the probability of emigrating. In addition, population affects the number of migrants in one country. The more population increases in one country, the more people migrate, even if the ratio of migrants to population is still the same. In developing countries, the more population increases, the greater is the burden on welfare systems. A large number of people of working age and an insufficient number of vacant jobs cause an increase in the unemployment rate. This motivates people to emigrate to find jobs. While in developed countries, the decline in the labour force makes governments loosen their migration policies in order to attract more immigrants. Thus, it is reasonable to include log GDP per capita and population as the control variables in this specification. These covariates are expected to be endogenous but have substantive importance in this specification. Because control variables have no causal meaning, I do not argue about the sign or magnitude of these coefficients.

The most serious challenge in estimating the causal effect of life expectancy on net migration is endogeneity problems. The variable of interest—life expectancy—might be correlated with the error term, which leads OLS estimates to be biased. Omitted variable bias and reverse causality are some sources of endogeneity problems in this model. In particular, the health environment could be endogenous to the migration decision, even conditional on fixed effects. For example, mean years of schooling is expected to be different across countries and change in time. Silles (2009) finds that correlation between health and education represents a causal relationship. Higher levels of schooling improve health. Moreover, education has a significant impact on the migration decision. The educated tend to emigrate more than do less educated people. The education variable is not only correlated with the health environment variable but also directly affects migration. A limitation of the dataset prevents us from including the education variable, which causes omitted variable bias. The significant effects of migration on migrants' health conditions and public health might lead to reverse causality – an important source of endogeneity.

Our empirical strategy is to exploit the potential exogenous source of variation in life expectancy because of global interventions. I use the global mortality rate as the instrumental variable to investigate the causal relationship between the health environment and migration flows. More specifically, my first-stage relationship is

$$X_{it} = \lambda M_{it}^{I} + \delta W_{it} + \omega_i + \Upsilon_i + u_{it} \qquad (2)$$

where M_{it}^{I} is the global mortality rate in country i at year t, which is discussed below. The exclusion restriction is valid if $Cov\,(M_{it}^{I}, \varepsilon_{it})=0$

Global mortality rate

In the estimation of the causal effects of life expectancy, this study uses the global mortality rate instrument proposed by Acemoglu and Johnson (2007). This instrument exploits information related to mortality reduction after the epidemiological transition in 1940s happened to predict the mortality decline. The exclusion restriction that the instrumental variable is exogenous to a particular country's level of net migration and have no direct effect to migration through any channels except life expectancy at birth seems valid as a result of the global character of three crucial innovations. By using a fixed-effect model, I can control for average differences across countries in any observable or unobservable predictors. What remains is the within-country action, which is what I focus on. The base sample consists of 36 countries for which the most relevant data on the global mortality rate instrument, life expectancy, and net migration in the second stage are available for 1940, 1950, 1960, and 1987. According to Acemoglu and Johnson (2007), "prior to the international epidemiological transition, there was considerable variation in the prevalence of diseases across the world. For example, during the 1940s, while malaria was endemic in parts of South Asia and Central America, it was relatively rare in much of Western Europe and in the Southern Cone of Latin America. We, therefore, expect variation in the effects of global interventions on life expectancy in different countries depending on the baseline distribution of diseases. For example, DDT should reduce malarial infections and mortality, and increase life expectancy in Central America and South Asia relative to Western Europe or the Southern Cone of Latin America" (p. 945-946).

This study uses constructed data for the global mortality instrument directly from Acemoglu and Johnson (2007). Specifically, the way to construct the € instrumental variable is explained in the formula (3):

$$M_{it}^{I} = \sum_{d \in D} \frac{M_{dt}}{M_{d40}} M_{di40} \quad (3)$$

"where M_{di40} denotes mortality in country i from disease d in 1940, M_{dt} (M_{d40}) is global mortality from disease d in year t(1940), calculated as the unweighted average across countries in my sample" (p.947), according to Acemoglu and Johnson (2007), and D includes 15 diseases[7]. By using aggregate changes in global disease-specific mortality rate, the global mortality instrument does not have any connection with global intervention dates. Therefore, none of my results has association with intervention dates. Because variations in global mortality rate are not linked to economic situation in a country, it is apparent that the instrument variable is uncorrelated with the migration process in a particular country. Thus, there is no correlation between global morality rate and any other determinants of net migration. The exclusion restriction condition of the instrumental variable is satisfied[8].

With the instrument relevance condition, the instrument must be correlated with endogenous explanatory variables, conditional on the other covariates. In this study, the global mortality rate is highly correlated with log life expectancy at birth, controlling for log GDP per capita and population. The instrument relevance condition is checked in the first stage, presented below.

Summary statistics

Table 1 provides descriptive statistics on the variables of interest for the estimation. The base sample partly corresponds to the base sample investigated by Acemoglu and Johnson (2007). For comparison, this study uses the base sample, in which average life expectancy at birth is 50.48 years in 1940, while the average in non-poor countries[9] equals 54.16 years. The trend in life expectancy

[7] The 15 diseases are "tuberculosis, malaria, pneumonia, influenza, cholera, typhoid, smallpox, whooping cough, measles, diphtheria, scarlet fever, yellow fever, plague, typhus fever, and dysentery" (Acemoglu and Johnson, 2007, p. 937).

[8] In a recent study, Bloom, Canning, and Fink (2014) find that initial life expectancy in 1940 is highly correlated with mortality. In addition, the initial life expectancy potentially affects economic growth. The authors point out that it is necessary to include initial life expectancy as the independent variable of the specification. However, Acemoglu and Johnson (2014) implement "three additional approaches for assessing the potential effects of initial life expectancy on subsequent changes in GDP per capita" (p. 1375). All these approaches confirm that my main results are robust: there is no evidence that the increase in life expectancy at birth after 1940 had a positive effect on GDP per capita growth. Because their study focuses on the effect of life expectancy on economic growth, the correlation between the predicted mortality rate and initial life expectancy worsens the estimated results. My study uses the alternative instrumental variable—the global mortality rate, which is highly correlated with the predicted mortality rate of Acemoglu and Johnson (2007). However, my study emphasizes the effect of life expectancy—a proxy for health environment—on net migration with the inclusion of GDP per capita and population as covariates. The non-correlation between the predicted mortality rate and GDP per capita once again supports that exclusion restriction of the instrument variable is satisfied.

[9] According to Acemoglu and Johnson (2007), "Throughout the study, the initial rich countries are those with income per capita in 1940 above the level of Argentina (the richest Latin America country at that time, according to Maddison's data [2003], in my base

increases in 1950, 1960, and 1987. Specifically, from 1940 to 1987, the increase in life expectancy at birth in the base sample country is 20.8 years; while in non-poor countries, it is 19.69 years. During the 1940–1987 period, the trend in migration increases in both base sample countries and non-poor countries. The value of net migration is positive, which means immigrants dominate emigrants.

Table 1. Descriptive statistic

		Base sample		Non-poor countries	
	Year	Mean	Std. Dev	Mean	Std. Dev
Life expectancy at birth	1940	50.48	12.18	54.16	10.88
	1950	59.19	10.41	63.54	7.25
	1960	63.38	8.76	67.10	5.96
	1987	71.28	5.66	73.85	3.30
Global mortality rate	1940	0.446	0.285	0.355	0.232
	1950	0.156	0.107	0.118	0.081
	1960	0.126	0.083	0.100	0.070
	1987	0	0	0	0
GDP per capita	1940	3417.25	1905.19	4058.84	1692.14
	1950	4069.70	2636.00	5010.30	2367.01
	1960	5285.98	3355.03	6541.05	2912.31
	1987	10007.42	6550.67	12493.12	5602.37
Net migration	1940	2842	9699	3324	10638
	1950	30070	251908	39851	282754
	1960	64849	352518	97623	401776
	1987	151797	759001	225654	858713
Crude death rate	1940	14.71	4.13	13.8	3.96
	1950	11.22	2.60	10.80	2.22
	1960	9.80	1.52	9.70	1.60
	1987	8.47	2.08	8.57	2.18
Population	1940	29337	68052	18428	28596
	1950	31256	63968	20390	31630
	1960	37046	76864	23407	36584
	1987	59728	135633	31506	48178
Infant mortality rate	1940	94.35	47.23	88.75	48.00
	1950	65.71	36.44	60.55	35.70
	1960	53.00	31.47	46.87	32.54
	1987	30.16	29.86	20.95	25.04

The global mortality rate decreases from 1940 to 1987[10] owing to innovations in medicine and vaccine inventions as well as efforts to improve health conditions. In non-poor countries, the global

sample)" (p. 927). Non-poor countries in my study, including rich and middle-income countries, are defined as countries that have income per capita higher than that of Portugal. Specifically, non-poor countries have log GDP per capita above 7.37 in 1940.

[10] Until 1940, there were limited improvements in health condition in most areas in the world. Thanks to global drug and chemical innovations around 1940, penicillin which is considered as the most important discovery provided effective treatments against various bacterial infections. By the early of 1950s, penicillin became more popular because of mass production. The establishment of World Health Organization and its effective operation from the 1950s is one of the main pillar in improving public health. The global mortality rate keeps decreasing until 0 from 1940 to 1987. After 1987, there is no changes in global mortality rate, that is the reason why I only keep the data set in 1940-1987 period.

mortality rate is smaller than in the base sample countries. Both the crude death rate and the infant mortality rate decrease as time goes by. Population increases as expected in both the base sample countries and non-poor countries.

Results

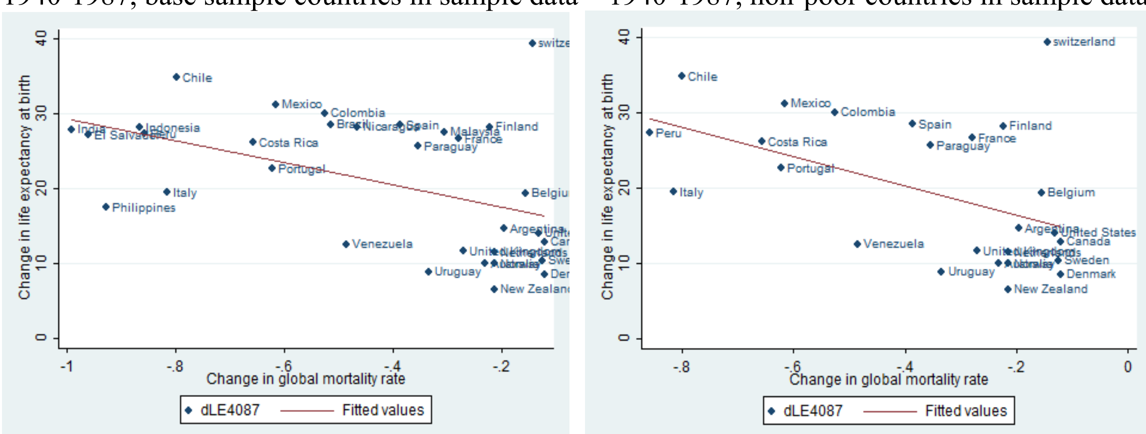
First-stage estimates

In the section, I investigate the first-stage relationship between life expectancy and the global mortality rate.

Figure 2 visually depicts the first-stage relationship informally (not controlling other variables). The horizontal axis is the change in the global mortality rate between 1940 and 1987, while the vertical axis is the change in log life expectancy during the same period. I focus on the 1940 – 1987 period, since 1940 represents a pre-intervention year and 1987 is the end of the sample for most of my specifications. A strong negative relationship is clearly visible in Figure 2.

Figure 2. Change in life expectancy at birth and global mortality rate

1940-1987, base sample countries in sample data   1940-1987, non-poor countries in sample data



Source: Demographic Year Book 1948 – 1990, and Acemoglu and Johnson (2007)

Figure 2 also depicts the same relationship in non-poor countries in the 1940 – 1987 period. It shows that the first-stage relationship is not driven by the comparison of poor countries to rich countries and middle-income countries.

Table 2 shows the first-stage relationship in regression form by estimating equation (2). Country and year fixed effects are included. The first column is my baseline specification. The estimated coefficient λ is significant at 1% in both base-sample countries and non-poor countries. The relevance of the instruments is tested in the first-stage regression. With the F-statistic of the joint test larger than 10, the global mortality rate is not a weak instrumental variable in the case of the base sample.

In column (2), in the case of non-poor countries, the F-statistic is smaller than 10. To deal with the weak instrumental variable problem, I use limited information maximum likelihood (LIML), which is expected to yield a less biased estimator and confidence intervals with better coverage rates than 2SLS estimators do (Anderson and Rubin, 1949).

Table 2. First-stage estimate

	(1)	**(2)**
Variables	Base sample	Non-poor countries
Global mortality rate	−0.329***	−0.359***
	[0.0866]	[0.123]
ln_GDPpercapita	0.0248	0.0326
	[0.0439]	[0.0521]
Population	5.08e-07***	7.57e-07
	[1.43e-07]	[9.42e-07]
Observations	137	104
R-squared	0.914	0.863
Country FE	YES	YES
Year FE	YES	YES
Number of countries	36	27
F-stat	14.44	8.53

Notes: *The first stage uses OLS for estimation. The dependent variable is log life expectancy, ln_LE. The variable of interest is the global mortality rate. The control variables are log GDP per capita and population. All specifications include country and time fixed effects. Robust standard errors are in brackets. *** p<0.01, ** p<0.05, * p<0.1.*

Two-stage least squares

I now present my main results by using 2SLS to show the effect of life expectancy on net migration. The control variables in the main specification include log GDP per capita and population. All specifications apply both country and time fixed effects.

In columns (1) and (2) of Table 3, I analyze the effects during 1940–1987 using OLS and find that the estimated coefficients in both the baseline countries and non-poor countries are negative and statistically significant at 5% level. Columns (3) and (4) present my main 2SLS second-stage results. I find that improving the health environment leads to a decrease in net migration, and this result is statistically significant at the 5% level. The magnitude of the 2SLS estimate is significantly larger than the magnitude of the OLS estimate. The estimated coefficients using LIML in columns (5) and (6) are similar to the values obtained using 2SLS except that there is a smaller standard error in the case of LIML. Interestingly, both the 2SLS and LIML estimated coefficients (−2,666) of the effect of the health environment on net migration are much larger than the corresponding OLS estimate (−1,294). The most likely reason for the difference is that the OLS estimator suffers from upward bias due to omitted variable bias and reverse causality. Specifically, education is an important factor affecting the decision to migrate. However, due to the time period of the sample, education cannot be included in the specification. When education level increases, both life expectancy and migration increase. The omission of education leads to upward bias in the OLS estimators.

Consider the case of non-poor countries. When life expectancy increases, net migration decreases in non-poor countries, and the coefficient is statistically significant at 5% in 2SLS and 1% in LIML. The magnitude of the coefficient using LIML is larger than that of the OLS estimates. The control variables – log GDP per capita and population – are insignificant in most of the specifications in Table 3.

The dependent variable, net migration, is the net effect of immigration and emigration on a country's population. Net migration decreases when immigration decreases or emigration increases. From the results in Table 3, an increase in life expectancy leads to a decrease in net migration. This shows that improvement in the health environment is negatively correlated with migration flows. The obtained results contradict my expectations. Therefore, in the next subsection, I perform robustness checks to show that the obtained results are credible.

Table 3. Two-stage least square

	OLS		**2SLS**		**LIML**	
	(1)	(2)	(3)	(4)	(5)	(6)
Variables	Base sample	Non-poor countries	Base sample	Non-poor countries	Base sample	Non-poor countries
ln_LE	−1,294**	−1,298**	−2,666**	−2,405**	−2,666**	−2,405***
	[600.5]	[566.5]	[1,231]	[979.2]	[1,057]	[842.6]
ln_GDPpercapita	−129.2	−250.7	−159.2	−233.8	−159.2	−233.8
	[309.0]	[400.4]	[346.8]	[472.1]	[297.8]	[406.2]
Population	9.05e-05	−0.00984	0.00118	−0.00849	0.00118*	−0.00849
	[0.000719]	[0.00823]	[0.000753]	[0.00726]	[0.000646]	[0.00625]
Observations	137	104	137	104	137	104
Number of countries	36	27	36	27	36	27
Country FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES

*Notes: The dependent variable is net migration. The variable of interest is log life expectancy—ln_LE, and the instrument is the global mortality rate. The control variables are log GDP per capita and population. All specifications include country and time fixed effects. Robust standard errors are in brackets. *** p<0.01, ** p<0.05, * p<0.1.*

Robustness check

In this subsection, I check the robustness of my 2SLS results presented in Table 3 by conducting four tests: 1) two alternative health variables are used; 2) extreme observations are dropped; and 3) sample selection bias is checked.

The purpose of this study is to investigate the effect of health environment on net migration. For the main specification, life expectancy is used as a proxy for the health environment. As the first robustness check, I apply different health indicators, including the crude death rate and infant mortality rate, instead of life expectancy at birth. Table 4 shows the results of regressing the two alternative indicators of the health environment on net migration. An increase in death indicators means that health environment worsens. The estimated coefficients on life expectancy and death variables are expected to be reversed. In Table 4, when the death variables decrease or the health environment improves, net migration decreases. The results are similar to the case of life expectancy at birth. Column (1) using 2SLS shows that the instrumental variable is not weak with the F-stat larger than 10. Columns (2), (4), and (6) have a weak instrumental variable problem. Therefore, I use LIML to make the estimators less biased.

The coefficients are statistically significant for the base sample and non-poor countries when the variable of interest is the crude death rate. In the case of the infant mortality rate, the 2SLS estimator is significant at 10% in both the base sample and non-poor countries. By using LIML, the estimators for both the base sample and non-poor countries are positive and significant at 10% and

5%, respectively. The signs of the coefficients are constant for all specifications. Thus, it appears that my results are robust in using different proxies for the health environment.

Table 4. Robustness check: Re-estimation with death indicators

	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Variables	Base sample	Non-poor countries	Non-poor countries	Base sample	Base sample	Non-poor countries	Non-poor countries
crude_death_rate	93.75**	78.73**	78.73***				
	[42.62]	[31.94]	[27.60]				
infant_mort_rate				12.66*	12.66*	9.765*	9.765**
				[7.508]	[6.480]	[5.385]	[4.654]
ln_GDPpercapita	−378.6	−562.1	−562.1	−271.5	−271.5	−515.2	−515.2
	[423.6]	[527.0]	[455.5]	[459.6]	[396.7]	[579.8]	[501.1]
Population	−0.00524	−0.00524	−0.00524	−0.0102	−0.0102	−0.0112	−0.0112
	[0.00615]	[0.00733]	[0.00633]	[0.00776]	[0.00670]	[0.00925]	[0.00800]
Observations	98	83	83	98	98	83	83
Number of countries	25	21	21	25	25	21	21
Estimator	2SLS	2SLS	LIML	2SLS	LIML	2SLS	LIML
F-stat	13.32	7.56		6.71		4.37	
Country FE	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES

*Notes: The dependent variable is net migration. The variables of interest are crude death rate and infant mortality rate, and the instrument is the global mortality rate. The control variables are log GDP per capita and population. All specifications include country and time fixed effects. Robust standard errors are in brackets. *** p<0.01, ** p<0.05, * p<0*

Second, I investigate whether the results are robust when dropping countries with extreme values in net migration. Specifically, the observations of net migration in Brazil are 0 in several years, indicating that there are strict migration regulations in this country. I run the regression again without the observations from Brazil, and the obtained results are still robust and statistically significant, even though the results in Panel A of Table 5 are smaller than the previous ones for the base sample countries. Because the instrumental variable is weak in the case of non-poor countries, I use LIML to obtain less biased estimator. The LIML estimator is significant at 1% compared to 5% in the 2SLS estimator.

Third, I check the sample selection bias to confirm the consistency of the results. Due to the limited number of countries in this study, it is reasonable to suspect that the results are significant only for the specific sample of countries, and not for the whole population. Because there are limited data for the global mortality rate, there are only 36 countries available for the 2SLS estimation. This number of countries is small compared to the number of countries in the world. Therefore, in Panel B of Table 5, I include more relevant data from other countries from 1950 to 1987 and regress the specifications with the interaction term of life expectancy and the dummy variable for the sample of 36 countries. This interaction term representing sample selection is insignificant for both the base sample and non-poor countries. Thus, sample selection bias has no effect on the estimated results. The base sample countries are expected to have similar characteristics to the more extensive list of countries.

Table 5. Robustness check: Sample selection

Variables	(1)	(2)	(3)
	Base sample	Non-poor countries	Non-poor countries
Panel A	Dropping countries with strict migration rules		
ln_LE	−2,691**	−2,405**	−2,405***
	[1,253]	[979.2]	[842.6]
Observations	133	104	104
Number of countries	35	27	27
Estimator	2SLS	2SLS	LIML
F-stat	14.45	8.50	
Panel B	Sample selection bias		
ln_LE	−643.6	−871.1*	
	[450.4]	[492.7]	
Sample36*ln_LE	−306.9	−162.6	
	[289.2]	[382.4]	
Observations	290	237	
Number of countries	87	72	

*Notes: All specifications include country and time fixed effects. Robust standard errors are in brackets. *** p<0.01, ** p<0.05, * p<0.1.*

Discussion

As mentioned in the introduction, there is lack of research focusing on the effect of the health environment on international migration flows. It appears reasonable that a better health environment increases migration flows. However, my findings seem to contradict initial expected results, but remain robust after performing robustness checks. Clemens (2014) points out that development does not reduce migration, as policymakers expect, but conversely, it encourages people in developing countries to emigrate more until those countries reach upper-middle income status. In addition, improvements in the health environment mean there is significant development of the healthcare system. Some effort is devoted in my study to explaining more clearly the positive relationship between development and migration.

Owing to limitations in the dataset, this study establishes only that there is a trend for the health environment to affect migration flows, but not the mechanism behind this moving trend. Therefore, it might be difficult to explain precisely why improvement in the health environment causes a decline in migration flows. However, extended family households might be one of the most appropriate reasons to explain the above-mentioned trend based on a possible increase in emigration.

In some countries where extended family households are widespread, it seems difficult for young people to emigrate or work and live far away from their parents. Children are responsible for taking care of their parents when they get older. Improvements in the health environment decrease the probability of sickness, as good health facilities and services are provided. Thus, children do not have to take care of their parents. This is why better a health environment makes the migration process more feasible for young people. In this case, only base on neoclassical economic theory, it is hard to explain this pattern. Employment or wage might be the motivation for migrants to emigrate but if they consider other social factors, for example, their parents' health, they might not decide to emigrate even though they have that desire. The application of various migration theories is necessary to give an appropriate explanation to any migration patterns. For a deep understanding of the mechanism of people's migration decisions when the health environment improves, further research based on micro data needs to be conducted.

Conclusion

In this study, I analyze the effect of one of the determinants of migration – the health environment – on migration flows, controlling for endogeneity problems. Previous studies related to the determinants of migration have not addressed the issue of causality appropriately. Thus, the innovation in my approach is its exploitation of "the international epidemiological transition, which led to potentially exogenous differential changes in mortality from a number of major diseases across the world" (Acemoglu and Johnson, 2007, p. 975). Exploiting these differential changes in the global mortality rate, based on Acemoglu and Johnson (2007), as an instrument for health environment, I estimate the effect on net migration of the health environment, using life expectancy at birth as a proxy. My results indicate that improving the health environment led to a significant decrease in net migration. In non-poor countries, I find a similar result of negative net migration when life expectancy increases. The estimated results are robust even after performing several robustness checks. In addition, it is important to emphasize the limitations of my results. First, even though I perform an additional test to check sample selection bias, the sample in this study is still limited. It is difficult to conclude for all countries. Due to data limitations, specifically, the relatively low number of poor countries for which there are suitable data, there is a lack of research on the effect of the health environment on net migration in these areas. Second, my research establishes only the trend effect of the health environment on net migration using macro data, but not the mechanism behind the migration movement. It is necessary to reinvestigate the effect of the health environment on net migration using micro data to understanding the mechanism of this mobility. Migration is complex process, affecting both origin and destination countries in various aspects of development. Furthermore, migration is considered a key solution for developed countries to deal with aging societies as well as shortfalls in the labor force. Understanding the mechanism of this movement is necessary for sustainable development in developed countries. Further research on the effect of the health environment on net migration needs to be emphasized in developing countries and the mechanism behind migrants' movements.

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