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02/2022

DOES HUMAN CAPITAL COMPENSATE FOR DEPOPULATION?

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Does human capital compensate for depopulation?

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Abstract

Fertility rates have been falling persistently over the past 50 years in most developed countries around the world. Simultaneously, the trend in outward migration from poorer to richer countries has been steady. These two forces have contributed to declining population growth and in some countries even to depopulation. In this paper, we quantify the extent to which the negative effect of decreasing fertility on the aggregate human capital stock of a country is compensated for by increasing education and health investments – both of which raise individual human capital. We find that declining fertility is not fully, but partly compensated when including the full set of countries in our regressions. When focusing on depopulation countries, the compensatory effect is substantially weaker and, in many specifications, even insignificant.

Keywords: Human capital, Fertility, Depopulation, International migration, Economic growth, Quality-quantity tradeoff

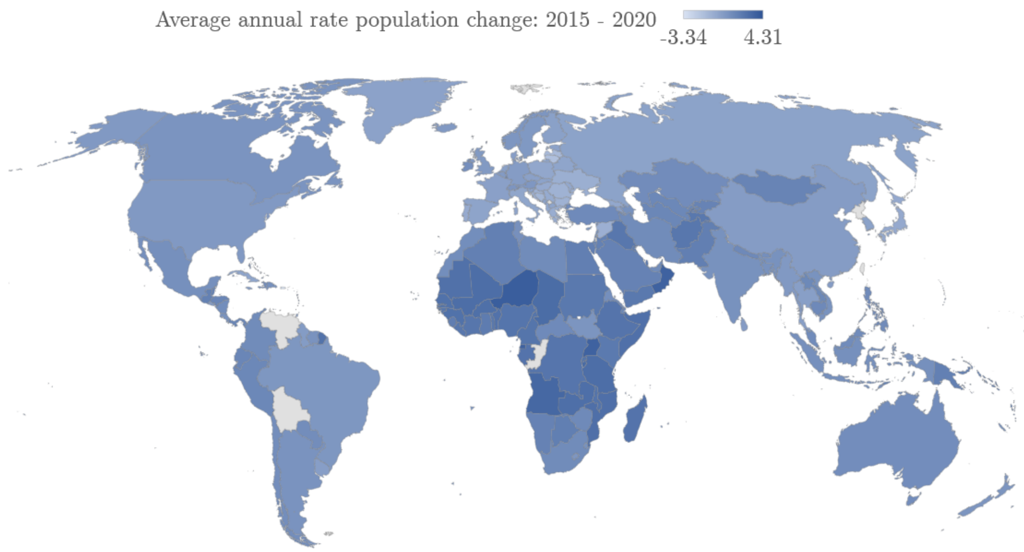
1. Introduction

Fertility rates have been falling persistently over the past 50 years in most developed countries around the world. Simultaneously, the trend in outward migration from poorer to richer countries has been steady. These two forces have contributed to declining population growth and in some countries even to depopulation. Figure 1 illustrates the expected changes in the population levels between the five-year time periods 2015–2020 and 2030–2035 from a global perspective. We observe that depopulation is expected to be particularly pronounced in Eastern Europe and some East Asian countries.

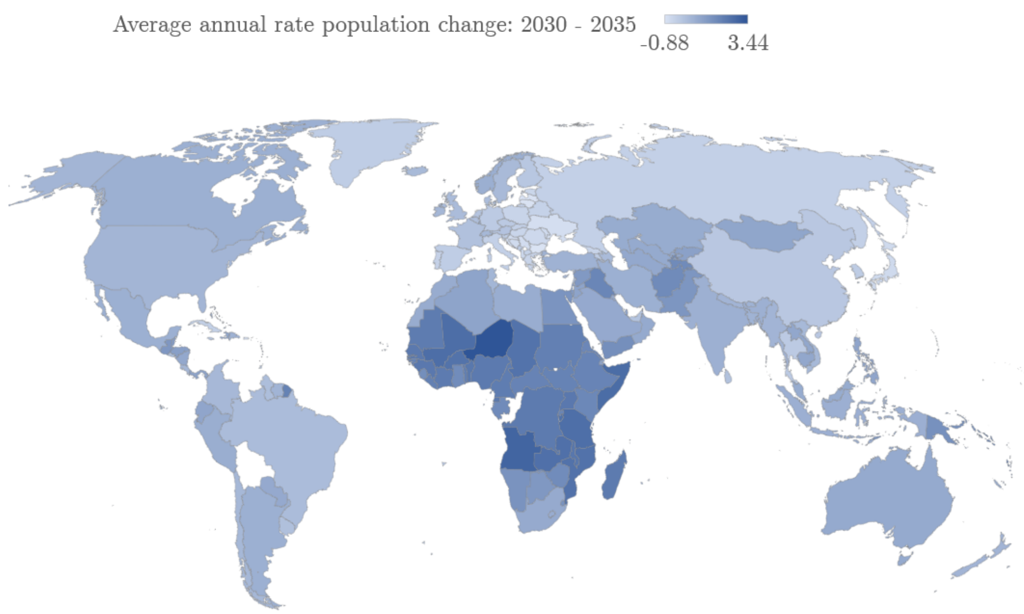
What are the long-term economic consequences of declining population growth? The answer to that question depends on the extent to which declining population growth can be compensated by other factors such as

Preprint submitted to N/A *May 9, 2022*

https://doi.org/10.1553/0x003d6ded



(a) Average annual rates of population change 2015-2020



(b) Average annual rates of population change 2030-2035

Figure 1: Average annual rates of population change are represented by the distinct shades of blue. The darker shades depict faster population growth, whereas the pale shades describe areas with low population growth and even population decline. Source: World Prospects.

human capital accumulation and immigration. In this paper, we focus on the former and control for the latter in our empirical analyses.

The quality-quantity tradeoff as explored by Becker (1960), Barro and Becker (1989), and Becker et al. (2015) shows that parental fertility levels and children's education and health are inversely related. Children's education and their health are the key components of their human capital, which, in turn, determines the aggregate human capital stock of the workforce after children have turned adults. Aggregate human capital as such plays an important role in economic growth theory because i) higher human capital means greater individual productivity, which increases output directly (Lucas, 1988), and ii) higher human capital enhances research and development (R&D) and thereby technological progress and productivity growth (Romer, 1990; Strulik et al., 2013). Thus, aggregate human capital is a key driver of long-run economic development (cf. Bils and Klenow, 2000; Mincer, 1981; Galor and Tsiddon, 1997; Galor, 2005, 2011; Lutz et al., 2008; Strulik et al., 2013) and thereby also of the well-being of the population (Charles Jones et al., 2016; Bloom et al., 2021).

For these reasons it is crucial to know the extent to which falling fertility can be compensated by increasing education and health investments. Figure 2 displays the relation between fertility (from World Bank, henceforth WB) and the human capital index[1] (from the Penn World Tables 10.0 revision, hereafter PWT), displaying an inverse relation and, thus, supporting the quality-quantity tradeoff hypothesis. Thus, a part of the potentially negative economic consequences of declining fertility could indeed be compensated by the accompanying increase in education and health investments (Prettner et al., 2013).

It is also worth mentioning that the interpretation of the effect of an increase in education levels by one year on the aggregate economy is not as straightforward as it may seem. This is because the increase by one year of average educational attainment in a country with high levels of education (10-12 years of schooling) may yield different economic gains as compared to a country with mostly primary education (up to 6 years of schooling). This is because an increase from a low level implies that central skills such

[1] The Human capital index is a measure comprised of an individual's years of education and the return of the investment on education in economic terms. Human capital as a measure captures the skills acquired through education which are used in economic processes and improve labor's productivity.

as reading and math are extended, which is essential in almost all jobs and helps the children themselves in their later lives to expand their knowledge further. By contrast, in a country with a higher education level, additional knowledge is comparatively specialized and the associated economic impact might not be as pronounced. A similar argument holds true with respect to health. In a country with bad population health and a comparatively low life expectancy, health improvements lead to higher productivity of the working age population. By contrast, health improvements in rich countries with a better population health status and high life expectancy mainly reduce mortality and morbidity of retirees with no immediate economic impact (Bloom et al., 2019b).

Declining fertility is often complemented or even superseded by net outward migration as a second important driver of population decline. This is often caused by a skill mismatch on the labor market and/or by low compensation for highly-skilled and mobile parts of the population. Highly educated workers are therefore more likely to emigrate to rich countries (Borjas, 2005), which, in turn, counteracts the economic gains from higher education and thereby reduces the compensatory effect of the quality-quantity trade-off. It is thus important that we control for migration in our empirical analysis.

We contribute to the literature on the scope for human capital investments to offset fertility decline along four dimensions: We extend the standard framework by i) including migration to control for a crucial demographic force that affects human capital accumulation; ii) splitting the sample into countries that are subject to depopulation and countries that are not, which allows us to compare the compensatory channel across countries with different demographic backgrounds. This is important because if the compensation effect was much stronger in depopulation countries than in countries in which the population is still growing, then depopulation might not be of such a concern for policymakers; iii) including more control variables such as corruption, agriculture, and institutions; and iv) extending the sample size by including more countries and time points.

The remainder of the study is structured as follows. In Section 2, we desribe how individual human capital can compensate for declining fertility within a production function framework rooted in economics; in Section 3, we present our empirical analysis; and in Section 4, we conclude.

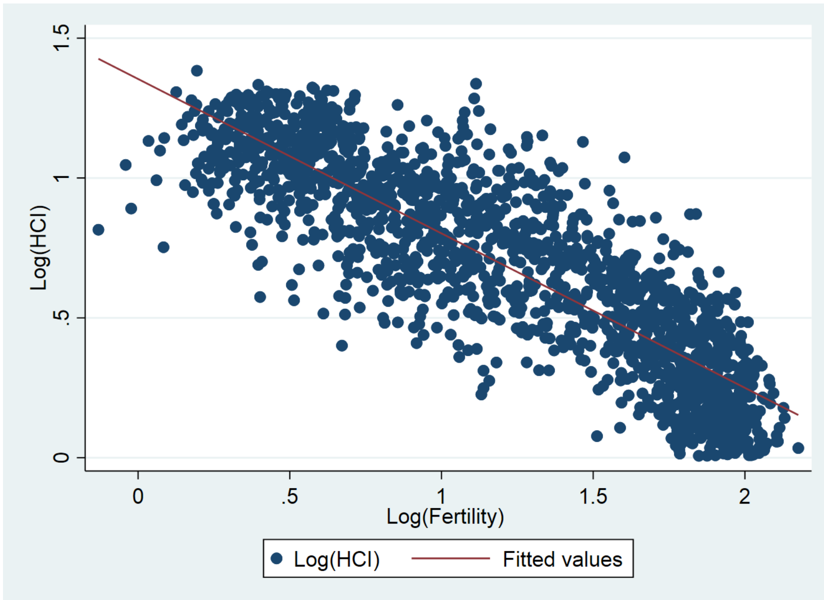


Figure 2: 5 year averages of the logarithmic transformations of human capital index (Henceforth HCI from PWT) and fertility rate (from WB) from 1960 to 2015

2. Theoretical considerations

We consider an economy in which time t evolves discretely and write time in the subscript of a variable. Final output Y_t is produced employing physical capital K_t, and aggregate human capital H_t, as determined by the fertility rate, n_t, multiplied with the size of the previous generation, N_{t-1}, and with individual human capital, h_t, such that $H_t = n_t h_t N_{t-1}$. Given the state of technology A_t, aggregate production amounts to

$$Y_t = A_t K_t^{\alpha} H_t^{1-\alpha} = A_t K_t^{\alpha} \left(n_t h_t N_{t-1}\right)^{1-\alpha}, \tag{1}$$

where α is the elasticity of output with respect to physical capital. Individual human capital h_t measures embodied productivity as determined by, e.g., educational attainment (as a proxy for education) and the adult survival rate (as a proxy for health). Overall, the economic consequences of changing fertility depend crucially on whether education and health investments rise in response to declining fertility to an extent that offsets the negative effect of falling fertility. Mathematically, the effect of declining fertility on economic growth depends on the elasticity of individual human capital with respect to fertility in the following ways:

$$\frac{\delta h_t}{\delta n_t} \cdot \frac{n_t}{h_t} \quad \begin{cases} \in (-\infty, -1) & \text{overcompensated,} \\ = -1 & \text{exactly compensated,} \\ \in (-1, 0) & \text{partly compensated,} \\ = 0 & \text{not compensated,} \\ \in (0, \infty) & \text{inconsistent with quality-quantity trade-off.} \end{cases} \tag{2}$$

As far as aggregate human capital is concerned, this condition states that a country's fall in fertility is a) being overcompensated by an increase in education and health investments for values of the elasticity lower than -1, b) partly compensated for values of the elasticity between -1 and 0, or c) exacerbated for values of the elasticity greater than zero. These ranges are separated by the knife-edge cases of full compensation precisely at the value of -1 and no compensation precisely at the value of 0. Values above 0 are inconsistent with the presence of a quality-quantity trade-off along the lines of Becker (1960), Barro and Becker (1989), and Becker et al. (2015) that implies a negative relation between fertility and education, which is supported empirically. However, the scenario may occur under special circumstances, in which a country's fertility would be low due to both a struggling economy that deters parents from having many children and, at the same time, implies that the few children are malnourished and lack a decent education. This may be relevant, for instance, in countries affected by infectious diseases as a primary cause of child mortality.

3. Empirical analysis

In this section, we estimate the elasticity of human capital with respect to fertility. We also elaborate on how the constructed measures of human capital included in our sensitivity analyses were created.

3.1. The data

To estimate the impact of fertility dynamics on human capital, in our benchmark regressions we use the Human Capital Index (henceforth HCI) from the PWT. This index is based on educational attainment, measured by average years of schooling from Barro and Lee (2013) and Cohen and

Leker (2014), to which a rate of return on education is applied that draws on the parameter estimates of a Mincer equation by Psacharopoulos (1994). However, the HCI has been criticized due to its construction methodology, which may be viewed as partial and incomplete when it comes to capturing human capital (e.g., due to the exclusion of individual health or a quality-weight on education). Hence, we constructed alternative measures of human capital based on Hall and Jones (1998), Bils and Klenow (2000), Prettner et al. (2013), and Jones (2014) and used them in our sensitivity analysis. Altogether, we constructed four measures of the human capital stock with two distinct sub-categories. The first category of the human capital stock uses the average years of schooling and is constructed as follows:

$$h_{i,t} = e^{\mathrm{RoH}_{i,t} \cdot S_{i,t} + \mathrm{RoE}_{i,t} \cdot ys_{i,t}}, \tag{3}$$

where $h_{i,t}$ is the average human capital stock of the working age population in country i in time t, $\mathrm{RoH}_{i,t}$ is the return on health as in Bloom et al. (2019a), $S_{i,t}$ is the adult survival rate, $\mathrm{RoE}_{i,t}$ refers to the return on education as surveyed in Psacharopoulos and Patrinos (2018), and $ys_{i,t}$ represents the average years of schooling. In including health alongside education, we follow Shastry and Weil (2003) and Weil (2007) who showed that health, as measured by the adult survival rate, has a long-term impact on the productivity of the labor force. Alternatively, we construct human capital in a more detailed way as

$$h_{i,t} = e^{\mathrm{RoH}_{i,t} \cdot S_{i,t} + \mathrm{RoE}^{prim}_{i,t} \cdot ys^{prim}_{i,t} + \mathrm{RoE}^{sec}_{i,t} \cdot ys^{sec}_{i,t} + \mathrm{RoE}^{tert}_{i,t} \cdot ys^{tert}_{i,t}}, \tag{4}$$

where we distinguish between the different levels of schooling, primary ($prim$), secondary (sec), and tertiary ($tert$). In so doing, we take the returns to the different levels of education from Hall and Jones (1998).

For each specification we employ two distinct sources for the return on health $\mathrm{RoH}_{i,t}$. This gives us four possible measures of the human capital stock, HCS1–HCS4, as presented in the 2x2 matrix in Table 1. HCS1 and HCS2 rely on the return on health assumed by (Prettner et al., 2013) and HCS3 and HCS4 rely on the return on health estimated by Weil (2007). HCS1 and HCS3 are constructed following equation (3), whereas HCS2 and HCS4 follow equation (4). The values of the respective RoE and RoH measures are given in Table 2.

We retrieved data on fertility ($Fert$), the population size, the adult survival rate, and gross fixed capital formation (GFCF) from the World

$\text{RoH}_{i,t}$ from	Strulik et al. (2013)	Weil (2014)
Eq. (3)	HCS1	HCS3
Eq. (4)	HCS2	HCS4

Table 1: Human capital stock and the data sources for each measure

	Measure	Value
RoE	Mincerian	0,087
	Primary	0,078
	Secondary	0,105
	Terciary	0,129
RoH	Strulik et al. (2013)	0,091
	Weil (2014)	0,067

Table 2: Values for all measures included rounded to 4 decimal spaces

Bank. Net Migration (Mig) stems from the Wittgenstein Centre Human Capital Data Explorer. The data on GDP and the HCI have been retrieved from the PWT where we compute per capita GDP ($GDPperCap$) using the population size data. The source for the education data is the Barro-Lee Educational Attainment Dataset (Barro and Lee, 2013). In addition, absence of corruption ($Corr$) was retrieved from The Global State of Democracy Indices and the value added of the agricultural sector as a share of GDP ($Agri$) was taken from FAO. The summary statistics are depicted in Table 3, where we apply a logarithmic transformation to all variables except for migration. Furthermore, $Fert$ refers to fertility, lagged by 2 periods, and $Trade$ represents exports and imports as a share of GDP. Note that a negative (positive) value of the variable Mig represents emigration (immigration) from (to) the respective country. The variables $NetOutFlow$ and $NetInFlow$ then represent the split of the variable Mig, where only the negative or positive side of the measure Mig is included, expressing the net outflow or net inflow migrant share of the population, respectively.[2]

[2]Note that when Mig variable has a positive value and cannot be included in the $NetOutFlow$ variable, we include a zero in our observations as it is not a missing variable but rather a point in time where no net out-migration is observed.

Variable	Mean	Std. Dev.	Min.	Max.	N
Log(HCI)	0.671	0.359	0.007	1.384	1737
Log(HCS1)	0.522	0.292	0.022	1.234	1573
Log(HCS2)	0.525	0.305	0.021	1.341	1573
Log(HCS3)	0.506	0.289	0.016	1.214	1573
Log(HCS4)	0.51	0.302	0.016	1.32	1573
Log(GDPperCap)	-5.046	1.22	-7.679	-1.344	1843
Log(Fert)	1.369	0.53	-0.131	2.176	2412
Mig	-0.001	0.058	-0.312	0.764	1978
NetOutFlow	-0.01	0.024	-0.312	0	2818
NetInFlow	0.013	0.047	0	0.764	1978
Agri	0.147	0.151	0	0.8	1559
GFCF	0.214	0.11	0.014	1.457	2008
Corr	0.468	0.208	0.009	1	1393
Trade	0.778	0.531	0.002	5.947	1654

Table 3: Summary statistics

3.1.1. Benchmark regressions

Given the structure of our data and its sources, we have an unbalanced panel with gaps. We use 5-year averages to account for fluctuations caused by business cycles. This allows us to analyze $T = 11$ periods from 1965 to 2015 (or sometimes less depending on data availability over time). We construct our benchmark regression using a fixed effects model to account for a country's individual characteristics in the following manner:

$$\log(h_{i,t}) = \beta_0 + \beta_1 \log(\text{Fert}_{i,t-n}) + \beta_2(\text{Mig}_{i,t}) + \beta_3 X_{i,t} + \varepsilon_{i,t}, \quad (5)$$

where $\log(h_{i,t})$ represents the human capital index in country i at time t, which is impacted primarily by the fertility rate $\log(\text{Fert}_{i,t-n})$ at time $t-n$ and net migration $(\text{Mig}_{i,t})$ at time t. We consider that the changes in fertility have a delayed impact on the human capital indicator and, hence, include the lag n of fertility instead of the current period t. The other control variables are contained in the matrix $X_{i,t}$, while $\varepsilon_{i,t}$ is the composite error term. Note that in some robustness checks we also include migration with lags 1 and 2. We employ fixed effects (FE) regressions for panel data to estimate equation (5).

4. Results

4.1. Benchmark regressions results

Our baseline regressions following the specification in equation (5) yield the results displayed in Table 4. Our regressions include fixed effects because the Hausman test found random effects to be an inappropriate choice due to individual country characteristics. Table 4 depicts the coefficient estimates for our main explanatory variables including fertility and migration. In case of fertility, the coefficient has the interpretation of an elasticity. We find that the aggregate human capital loss following the reduction in the workforce under declining fertility is being partly compensated by a 0.117% increase (at the 1% significance level) in individual human capital through education investments (and some which also include health investments). Thus, a 1% fertility drop is associated with an increase of 0.117% in average human capital. This implies that the fall in fertility is only partly compensated by increases in human capital and the effect is comparatively small. However, this finding is qualitatively and quantitatively consistent with the literature to date (Prettner et al., 2013).

The net migration share of the population[3] in our benchmark regression is found to be negative and statistically significant at the 5% level. Note that net migration share is not in logs and hence its interpretation differs. The negative sign of net migration on average human capital is consistent with a composition effect that arises when (a) there is a cascading flow of migration from lower income countries with low human capital to higher income countries with higher human capital and (b) the human capital of migrants exceeds the average human capital in the country of origin but falls short of the average human capital in the host country. Such a pattern would imply that migration reduces average human capital in both the country of origin and the receiving country.

To capture the impact of changing fertility on human capital in countries affected by depopulation, we run our benchmark regression maintaining the same control variables but for the sub-sample comprised solely of countries experiencing depopulation. The depopulation trend can be attributed to either long-term fertility decline or outward migration tendencies or rather, a combination of both. The criterion for selecting the sample of depopulation

[3]Where net migration represents the difference between immigration and emigration in relation to a country's population size.

Table 4: Results for all countries using HCI as a measure of human capital

VARIABLES	(1) HCI No Mig	(2) HCI Mig
Log(Fert)[b]	-0.117***	-0.105***
	(0.015)	(0.016)
Mig		-0.134**
		(0.058)
Observations	903	805
R-squared	0.848	0.840
Number of id	113	100
State FE	YES	YES
Year FE	YES	YES

[a] St. errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.
[b] Fert represents a ,L= of 2 for log(Fertility)
[c] Mig is the net migration share of population
[d] The controls included the log of GDP per capita, agriculture, absence of corruption, gross fixed capital formation and Trade of GDP. For complete table see Appendix tables A.1-6

Table 5: Results for depopulation countries

VARIABLES	(1) HCI No Mig	(2) HCI Mig
Log(Fert)	-0.103***	-0.073***
(0.023)	(0.027)	
Mig		-0.469***
		(0.153)
Observations	182	156
R-squared	0.923	0.923
Number of id	26	22
State FE	YES	YES
Year FE	YES	YES

[a] St. errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.
[b] Fert represents a lag of 2 for log(Fertility)
[c] Mig is the net migration share of population
[d] The controls included the log of GDP per capita, agriculture, absence of corruption, gross fixed capital formation and Trade of GDP and GDP per capita. For complete table see Appendix tables A.1-6

countries is based on the United Nation's World Population Prospects predicted population decline for the year 2030. The 50 countries with the strongest decline in their population size have been selected into this group. Note that in some regressions this number is lower due to an insufficient number of observations. The results are depicted in Table 5.

We find that the elasticity of human capital with respect to changes in fertility is -0.103% ($p<0.01$) without controlling for migration and falls to -0.073% when including migration in the specification. Hence, the results again indicate a partial compensation of the effect of fertility decline on aggregate human capital accumulation. However, the magnitude of the effect is even smaller in depopulation countries compared to the full set of countries. Indeed, comparing the coefficients on the fertility variable reported in Tables 4 and 5, respectively, we find the elasticity in depopulation countries - when migration is controlled for - to be some 30% lower in absolute terms than in the overall set of countries. Additionally, the relation between the net migration share of the population and human capital in depopulation countries is both negative and statistically significant at the 1% level.

In further robustness checks (see the Appendix), we split the net migration variable into a positive (net inflow) and a negative (net outflow) variable and use these in our regression (e.g. see 1). We find that a net inflow of migrants in the complete set of countries tends to have a positive sign, whereas out-migration has a negative sign. We suspect, given our findings, that the share of the population with human capital above a skill level that is properly compensated by the labor market will leave for another country where labor market conditions are better. In the case of depopulation countries, we find consistently that both inflow and outflow migration tends to be negatively associated with average human capital. We speculate that this may be due to the fact that the high-skilled leave these countries (representing mainly Eastern European and Balkan countries), for places with better job opportunities in, e.g., Western Europe. Western European countries exhibit both better rewards for high-skilled workers as well as a greater overall size of the labor market. We also expect that the reason behind the negative impact of the inflow of immigrants on average human capital levels in Balkan countries and in Eastern European countries is because these immigrants have lower human capital levels compared to the average in Western European countries.

4.2. Sensitivity analysis

To verify the robustness of our results, we used the constructed human capital stocks (see Table 1). These include health effects and allow for distinct levels of compensation for various levels of educational attainment. The results of our sensitivity analyses and the contrast between the results based on HCI versus HCS is depicted in Table 6. The results are robust across the different measures of human capital. The fertility elasticity changes when migration is controlled for, where the compensation effect falls by some 0.01 to 0.015 percentage points across measures. Hence, when migration is considered, we find a consistently lower compensation effect of fertility decline on human capital throughout all of our measures. However, we do find lower values of compensation of fertility decline on human capital for HCS's compared to HCI in regressions both with and without migration. This difference between HCI and HCS is about 0.025 percentage points in most cases. This tendency would indicate that when human capital is composed of both education and health investments, the compensation of fertility loss on aggregate human capital is further diminished.

Table 6: Results for all countries and all measures of human capital - both HCI and HCS

VARIABLES	(1) HCI No Mig	(2) HCI Mig	(3) HCS1 No Mig	(4) HCS1 Mig	(5) HCS2 No Mig	(6) HCS2 Mig	(7) HCS3 No Mig	(8) HCS3 Mig	(9) HCS3 No Mig	(10) HCS3 Mig
Log(Fert)[b]	-0.117***	-0.105***	-0.088***	-0.078***	-0.092***	-0.077***	-0.088***	-0.078***	-0.092***	-0.077***
	(0.015)	(0.016)	(0.012)	(0.014)	(0.014)	(0.015)	(0.012)	(0.014)	(0.014)	(0.015)
Mig		-0.134**		-0.058		-0.066		-0.059		-0.068
		(0.058)		(0.045)		(0.049)		(0.045)		(0.049)
Observations	903	805	770	685	770	685	770	685	770	685
R-squared	0.848	0.840	0.880	0.874	0.878	0.873	0.877	0.872	0.876	0.871
Number of id	113	100	109	96	109	96	109	96	109	96
State FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

[a] Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.
[b] Fert represents a lag of 2 for log(Fertility)
[c] Mig is the net migration share of population
[d] The controls included the logarithmic transformation of GDP per capita, agriculture, absence of corruption, gross fixed capital formation and Trade of GDP. For complete table see Appendix tables A.1-6

We also conducted the sensitivity analysis including HCI and HCS for depopulation countries (see Table 7). However, we found that HCS's measures are statistically insignificant. Only HCI was statistically significant before and after the inclusion of migration. The lack of statistical significance may stem from i) no effect being present in the first place or ii) the number of observations being too low to get significant coefficient estimates. Furthermore, the fertility elasticities in all human capital stocks are bearing a positive sign. Hence, if they were statistically significant, they would imply that fertility decline is not even partially offset by education and health investments; even worse, the quality-quantity trade-off itself would not be consistent with the data. Overall, this result supports our main finding that the compensatory effect of rising human capital investments in case of fertility decline is weaker in depopulation countries than in countries with population growth.

Table 7: Results for depopulation countries using all measures of human capital - both HCI and HCS

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
VARIABLES	HCI No Mig	HCI Mig	HCS1 No Mig	HCS1 Mig	HCS2 No Mig	HCS2 Mig	HCS3 No Mig	HCS3 Mig	HCS3 No Mig	HCS3 Mig
Log(Fert)	-0.103***	-0.073***	0.010	0.038	0.017	0.044	0.010	0.038	0.018	0.044
	(0.023)	(0.027)	(0.029)	(0.031)	(0.033)	(0.037)	(0.029)	(0.031)	(0.033)	(0.037)
Mig		-0.469***		-0.262		-0.152		-0.263		-0.154
		(0.153)		(0.175)		(0.207)		(0.175)		(0.207)
Observations	182	156	156	134	156	134	156	134	156	134
R-squared	0.923	0.923	0.934	0.940	0.933	0.935	0.933	0.939	0.932	0.935
Number of id	26	22	26	22	26	22	26	22	26	22
State FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

[a] Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.
[b] Fert represents a lag of 2 for log(Fertility)
[c] Mig is the net migration share of population
[d] The controls included the logarithmic transformation of GDP per capita, agriculture, absence of corruption, gross fixed capital formation and Trade of GDP. For complete table see Appendix tables A.1-6

5. Conclusion

We study how fertility decline is being compensated by increases in education and health investments. We extend the standard framework by i) including migration to control for a crucial demographic force that affects human capital accumulation, ii) considering a sub-sample of countries that are subject to depopulation besides the full sample of all countries, iii) including more control variables such as corruption, agriculture, and institutions and iv) extending the database by including more countries and time points. We also used several measures for the human capital stock to carry out extensive sensitivity analyses.

Although fertility rates have been declining in all countries, this decline has had the most severe adverse effects on aggregate human capital in the countries experiencing depopulation in as far as these countries had less scope to compensate declines in fertility through increases in individual-level human capital. These countries have also been subject to a rapid outward migration to richer countries. We find that declining fertility is being partly compensated by increasing education and health investments when all countries are included in our regressions. According to our results, the elasticity of individual human capital with respect to fertility is on average -0.117%. This elasticity falls by additional 0.014 percentage points for depopulation countries; it falls further when migration is included to levels equal to -0.105 and -0.073 for the full sample and depopulation countries, respectively.

Promising avenues for future research include studying the impact of fertility changes on per capita GDP growth in depopulation countries and to disentangle the effects of emigration and immigration on human capital measures.

Acknowledgements

We would like to thank the participants at the 2021 Wittgenstein Centre conference "The causes and consequences of depopulation" in Vienna for valuable comments and suggestions.

Appendix

The appendix is comprised of tables A.1-A.10 containing regression with different measures of the migration. Further, each regression uses a distinct lag specifications for each measure of migration. Tables are either those for full or sub-sample of the countries. Five tables for each - full and sub-sample- correspond to the different measures of human capital used as a dependent variable. One measure of human capital was retrieved from the PWT 10.0 and the other four we constructed (see Table 1).

A.1: Complete results for all countries using HCI as a dependent variable

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
VARIABLES	HCI No Mig	Mig	Mig L1	Mig L2	Out Mig	Out Mig L1	Out Mig L2	In Mig	In Mig L1	In Mig L2
Log(GDPperCap)	0.009	0.013	0.008	0.009	0.010	0.009	0.008	0.012	0.006	0.009
	(0.008)	(0.009)	(0.009)	(0.009)	(0.008)	(0.008)	(0.008)	(0.009)	(0.009)	(0.009)
Log(Fert)	-0.117***	-0.105***	-0.107***	-0.106***	-0.117***	-0.116***	-0.118***	-0.105***	-0.107***	-0.106***
	(0.015)	(0.016)	(0.016)	(0.016)	(0.014)	(0.015)	(0.015)	(0.016)	(0.016)	(0.016)
Mig		-0.134**								
		(0.058)								
Agri	-0.081	-0.100*	-0.110*	-0.108*	-0.088*	-0.081	-0.080	-0.098*	-0.120**	-0.108*
	(0.054)	(0.059)	(0.059)	(0.059)	(0.053)	(0.054)	(0.054)	(0.059)	(0.059)	(0.059)
GFCF	-0.043	-0.049	-0.049	-0.048	-0.047	-0.042	-0.042	-0.047	-0.050	-0.048
	(0.034)	(0.036)	(0.036)	(0.036)	(0.034)	(0.034)	(0.034)	(0.036)	(0.036)	(0.036)
Corr	-0.034	-0.035	-0.034	-0.035	-0.032	-0.034	-0.035	-0.036	-0.032	-0.035
	(0.034)	(0.037)	(0.037)	(0.037)	(0.034)	(0.034)	(0.035)	(0.037)	(0.037)	(0.037)
Trade	-0.017	-0.020	-0.019	-0.020	-0.019*	-0.017	-0.017	-0.019	-0.018	-0.020
	(0.011)	(0.012)	(0.012)	(0.012)	(0.011)	(0.011)	(0.011)	(0.012)	(0.012)	(0.012)
NetMig,L=1			0.038							
			(0.057)							
NetInMig,L=2				0.112*						0.112*
				(0.068)						(0.068)
NetOutFlow					-0.291**					
					(0.116)					
NetOutMig,L=1						-0.148				
						(0.112)				
NetOutMig,L=2							0.065			
							(0.109)			
NetInFlow								-0.103		
								(0.072)		
NetInMig,L=1									0.119*	
									(0.071)	
Observations	903	805	805	805	903	903	903	805	805	805
R-squared	0.848	0.840	0.839	0.840	0.849	0.848	0.848	0.840	0.840	0.840
Number of id	113	100	100	100	113	113	113	100	100	100
State FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

[a] Standard errors in parentheses, *** $p<0.01$, ** $p<0.05$, * $p<0.1$.
[b] Fert represents a lag of 2 for log(Fertitily), Mig is the net migration share of population, Agri is the log(Agricultural Value Added), Corr is the absence of corruption and trade is the share of trade in terms of GDP, GDP represents Log(GDP per Capita)
[c] L1 represents a lag of 1 period of a variable standing before it and L2 the lag of 2 periods.

A.2: Complete results for all countries using HCI as a dependent variable for countries experiencing depopulation

VARIABLES	(1) HCI No Mig	(2) Mig	(3) Mig L1	(4) Mig L2	(5) Out Mig	(6) Out Mig L1	(7) Out Mig L2	(8) In Mig	(9) In Mig L1	(10) In Mig L2
Log(GDPperCap)	0.030*	0.018	0.016	0.012	0.033**	0.032**	0.031**	0.016	0.013	0.012
	(0.016)	(0.017)	(0.018)	(0.018)	(0.015)	(0.016)	(0.016)	(0.018)	(0.018)	(0.018)
Log(Fert)	-0.103***	-0.073***	-0.081***	-0.087***	-0.093***	-0.098***	-0.102***	-0.076***	-0.083***	-0.087***
	(0.023)	(0.027)	(0.027)	(0.027)	(0.023)	(0.023)	(0.023)	(0.028)	(0.028)	(0.027)
Mig		-0.469***								
		(0.153)								
Agri	-0.003	-0.060	-0.028	-0.032	-0.046	-0.004	-0.003	-0.021	-0.026	-0.032
	(0.079)	(0.082)	(0.084)	(0.084)	(0.078)	(0.078)	(0.079)	(0.083)	(0.084)	(0.084)
GFCF	0.037	0.107*	0.092	0.087	0.055	0.049	0.038	0.103*	0.086	0.087
	(0.055)	(0.058)	(0.060)	(0.060)	(0.054)	(0.055)	(0.055)	(0.060)	(0.060)	(0.060)
Corr	-0.030	-0.039	-0.043	-0.055	-0.011	-0.013	-0.038	-0.060	-0.058	-0.055
	(0.043)	(0.047)	(0.049)	(0.049)	(0.042)	(0.044)	(0.045)	(0.048)	(0.049)	(0.049)
Trade	0.002	0.007	0.020	0.024	-0.013	-0.002	0.002	0.022	0.024	0.024
	(0.017)	(0.020)	(0.020)	(0.020)	(0.017)	(0.017)	(0.017)	(0.020)	(0.020)	(0.020)
NetMig,L=1			-0.211							
			(0.143)							
NetInMig,L=2				0.367						0.367
				(0.420)						(0.420)
NetOutFlow					-0.541***					
					(0.169)					
NetOutMig,L=1						-0.278*				
						(0.158)				
NetOutMig,L=2							0.098			
							(0.148)			
NetInFlow								-0.778*		
								(0.416)		
NetInMig,L=1									-0.320	
									(0.421)	
Observations	182	156	156	156	182	182	182	156	156	156
R-squared	0.923	0.923	0.919	0.918	0.929	0.925	0.924	0.920	0.918	0.918
Number of id	26	22	22	22	26	26	26	22	22	22
State FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

[a] Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.
[b] Fert represents a lag of 2 for log(Fertitily), Mig is the net migration share of population, Agri is the log(Agricultural Value Added), Corr is the absence of corruption and trade is the share of trade in terms of GDP
[c] For variables Q1-Q4 see Figure 1, fertCat is a categorical variable of fertility levels, OutMig is the depiction of net out-migration, where positive values take values of zero and the exact opposite goes for InMig, which encompasses positive values only and zero otherwise.
[d] columns (10)-(18) are regressions corresponding to the sub-sample of countries which are experiencing depopulation
[e] L1 represents a lag of 1 period of a variable standing before it and L2 the lag of 2 periods.

A.3: Results for all countries using HCS1 as a dependent variable

VARIABLES	(1) HCI No Mig	(2) Mig	(3) Mig L1	(4) Mig L2	(5) Out Mig	(6) Out Mig L1	(7) Out Mig L2	(8) In Mig	(9) In Mig L1	(10) In Mig L2
Log(GDPperCap)	0.043***	0.045***	0.040***	0.043***	0.044***	0.043***	0.043***	0.044***	0.040***	0.043***
	(0.007)	(0.008)	(0.008)	(0.008)	(0.007)	(0.007)	(0.007)	(0.008)	(0.008)	(0.008)
Log(Fert)	-0.088***	-0.078***	-0.080***	-0.078***	-0.088***	-0.088***	-0.088***	-0.078***	-0.079***	-0.078***
	(0.012)	(0.014)	(0.014)	(0.014)	(0.012)	(0.012)	(0.012)	(0.014)	(0.014)	(0.014)
Mig		-0.058								
		(0.045)								
Agri	0.081*	0.063	0.052	0.058	0.077	0.081*	0.081*	0.064	0.048	0.058
	(0.047)	(0.051)	(0.052)	(0.051)	(0.047)	(0.047)	(0.047)	(0.052)	(0.052)	(0.051)
GFCF	-0.140***	-0.145***	-0.147***	-0.146***	-0.142***	-0.140***	-0.140***	-0.144***	-0.148***	-0.146***
	(0.030)	(0.033)	(0.033)	(0.033)	(0.031)	(0.031)	(0.031)	(0.033)	(0.033)	(0.033)
Corr	0.033	0.031	0.033	0.031	0.035	0.033	0.034	0.031	0.034	0.031
	(0.028)	(0.030)	(0.030)	(0.030)	(0.028)	(0.028)	(0.028)	(0.030)	(0.030)	(0.030)
Trade	0.016	0.022**	0.023**	0.023**	0.015	0.016	0.016	0.023**	0.024**	0.023**
	(0.010)	(0.011)	(0.011)	(0.011)	(0.010)	(0.010)	(0.010)	(0.011)	(0.011)	(0.011)
NetMig,L=1			0.051							
			(0.044)							
NetInMig,L=2				-0.011						-0.011
				(0.073)						(0.073)
NetOutFlow					-0.124					
					(0.089)					
NetOutMig,L=1						0.008				
						(0.087)				
NetOutMig,L=2							-0.026			
							(0.084)			
NetInFlow								-0.046		
								(0.056)		
NetInMig,L=1									0.081	
									(0.054)	
Observations	770	685	685	685	770	770	770	685	685	685
R-squared	0.880	0.874	0.874	0.874	0.880	0.880	0.880	0.874	0.874	0.874
Number of id	109	96	96	96	109	109	109	96	96	96
State FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

[a] Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.
[b] Fert represents a lag of 2 for log(Fertitily), Mig is the net migration share of population, Agri is the log(Agricultural Value Added), Corr is the absence of corruption and trade is the share of trade in terms of GDP
[c] For variables Q1-Q4 see Figure 1, fertCat is a categorical variable of fertility levels, OutMig is the depiction of net out-migration, where positive values take values of zero and the exact opposite goes for InMig, which encompasses positive values only and zero otherwise.
[d] columns (10)-(18) are regressions corresponding to the sub-sample of countries which are experiencing depopulation
[e] L1 represents a lag of 1 period of a variable standing before it and L2 the lag of 2 periods.

A.4: Results for all countries using HCS2 as a dependent variable

VARIABLES	(1) HCI No Mig	(2) Mig	(3) Mig L1	(4) Mig L2	(5) Out Mig	(6) Out Mig L1	(7) Out Mig L2	(8) In Mig	(9) In Mig L1	(10) In Mig L2
Log(GDPperCap)	0.054***	0.057***	0.052***	0.054***	0.055***	0.054***	0.054***	0.056***	0.052***	0.054***
	(0.008)	(0.009)	(0.009)	(0.009)	(0.008)	(0.008)	(0.008)	(0.009)	(0.009)	(0.009)
Log(Fert)	-0.092***	-0.077***	-0.079***	-0.077***	-0.092***	-0.092***	-0.092***	-0.077***	-0.078***	-0.077***
	(0.014)	(0.015)	(0.015)	(0.015)	(0.014)	(0.014)	(0.014)	(0.015)	(0.015)	(0.015)
Mig		-0.066								
		(0.049)								
Agri	0.132**	0.121**	0.109*	0.113**	0.128**	0.132**	0.132**	0.122**	0.106*	0.113**
	(0.051)	(0.056)	(0.057)	(0.057)	(0.052)	(0.051)	(0.051)	(0.057)	(0.057)	(0.057)
GFCF	-0.190***	-0.194***	-0.197***	-0.197***	-0.193***	-0.191***	-0.191***	-0.193***	-0.197***	-0.197***
	(0.034)	(0.036)	(0.036)	(0.036)	(0.034)	(0.034)	(0.034)	(0.036)	(0.036)	(0.036)
Corr	0.051*	0.050	0.052	0.051	0.053*	0.051*	0.052*	0.050	0.052	0.051
	(0.031)	(0.033)	(0.033)	(0.033)	(0.031)	(0.031)	(0.031)	(0.033)	(0.033)	(0.033)
Trade	0.028**	0.035***	0.036***	0.037***	0.027**	0.028**	0.028***	0.035***	0.037***	0.037***
	(0.011)	(0.012)	(0.012)	(0.012)	(0.011)	(0.011)	(0.011)	(0.012)	(0.012)	(0.012)
NetMig,L=1			0.045							
			(0.048)							
NetInMig,L=2				-0.028						-0.028
				(0.080)						(0.080)
NetOutFlow					-0.124					
					(0.098)					
NetOutMig,L=1						0.025				
						(0.096)				
NetOutMig,L=2							-0.022			
							(0.093)			
NetInFlow								-0.059		
								(0.062)		
NetInMig,L=1									0.065	
									(0.060)	
Observations	770	685	685	685	770	770	770	685	685	685
R-squared	0.878	0.873	0.873	0.873	0.878	0.878	0.878	0.873	0.873	0.873
Number of id	109	96	96	96	109	109	109	96	96	96
State FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

[a] Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.
[b] Fert represents a lag of 2 for log(Fertitily), Mig is the net migration share of population, Agri is the log(Agricultural Value Added), Corr is the absence of corruption and trade is the share of trade in terms of GDP
[c] For variables Q1-Q4 see Figure 1, fertCat is a categorical variable of fertility levels, OutMig is the depiction of net out-migration, where positive values take values of zero and the exact opposite goes for InMig, which encompasses positive values only and zero otherwise.
[d] columns (10)-(18) are regressions corresponding to the sub-sample of countries which are experiencing depopulation
[e] L1 represents a lag of 1 period of a variable standing before it and L2 the lag of 2 periods.

A.5: Results for all countries using HCS3 as a dependent variable

VARIABLES	(1) HCI No Mig	(2) Mig	(3) Mig L1	(4) Mig L2	(5) Out Mig	(6) Out Mig L1	(7) Out Mig L2	(8) In Mig	(9) In Mig L1	(10) In Mig L2
Log(GDPperCap)	0.043***	0.045***	0.040***	0.042***	0.043***	0.043***	0.043***	0.044***	0.040***	0.042***
	(0.007)	(0.008)	(0.008)	(0.008)	(0.007)	(0.007)	(0.007)	(0.008)	(0.008)	(0.008)
Log(Fert)	-0.088***	-0.078***	-0.080***	-0.078***	-0.087***	-0.088***	-0.087***	-0.078***	-0.079***	-0.078***
	(0.012)	(0.014)	(0.014)	(0.014)	(0.012)	(0.012)	(0.012)	(0.014)	(0.014)	(0.014)
Mig		-0.059								
		(0.045)								
Agri	0.083*	0.066	0.055	0.061	0.079*	0.083*	0.083*	0.067	0.051	0.061
	(0.047)	(0.051)	(0.052)	(0.052)	(0.047)	(0.047)	(0.047)	(0.052)	(0.052)	(0.052)
GFCF	-0.142***	-0.147***	-0.149***	-0.148***	-0.144***	-0.142***	-0.142***	-0.146***	-0.149***	-0.148***
	(0.031)	(0.033)	(0.033)	(0.033)	(0.031)	(0.031)	(0.031)	(0.033)	(0.033)	(0.033)
Corr	0.033	0.030	0.031	0.030	0.035	0.033	0.033	0.029	0.033	0.030
	(0.028)	(0.030)	(0.030)	(0.030)	(0.028)	(0.028)	(0.028)	(0.030)	(0.030)	(0.030)
Trade	0.016	0.022*	0.023**	0.023**	0.015	0.016	0.016	0.022**	0.024**	0.023**
	(0.010)	(0.011)	(0.011)	(0.011)	(0.010)	(0.010)	(0.010)	(0.011)	(0.011)	(0.011)
NetMig,L=1			0.051							
			(0.044)							
NetInMig,L=2				-0.010						-0.010
				(0.073)						(0.073)
NetOutFlow					-0.133					
					(0.089)					
NetOutMig,L=1						0.002				
						(0.087)				
NetOutMig,L=2							-0.026			
							(0.084)			
NetInFlow								-0.044		
								(0.056)		
NetInMig,L=1									0.082	
									(0.055)	
Observations	770	685	685	685	770	770	770	685	685	685
R-squared	0.877	0.872	0.872	0.872	0.878	0.877	0.877	0.872	0.872	0.872
Number of id	109	96	96	96	109	109	109	96	96	96
State FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

[a] Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.
[b] Fert represents a lag of 2 for log(Fertitily), Mig is the net migration share of population, Agri is the log(Agricultural Value Added), Corr is the absence of corruption and trade is the share of trade in terms of GDP
[c] For variables Q1-Q4 see Figure 1, fertCat is a categorical variable of fertility levels, OutMig is the depiction of net out-migration, where positive values take values of zero and the exact opposite goes for InMig, which encompasses positive values only and zero otherwise.
[d] columns (10)-(18) are regressions corresponding to the sub-sample of countries which are experiencing depopulation
[e] L1 represents a lag of 1 period of a variable standing before it and L2 the lag of 2 periods.

A.6: Results for all countries using HCS4 as a dependent variable

VARIABLES	(1) HCI No Mig	(2) Mig	(3) Mig L1	(4) Mig L2	(5) Out Mig	(6) Out Mig L1	(7) Out Mig L2	(8) In Mig	(9) In Mig L1	(10) In Mig L2
Log(GDPperCap)	0.053***	0.057***	0.052***	0.054***	0.054***	0.053***	0.054***	0.056***	0.052***	0.054***
	(0.008)	(0.009)	(0.009)	(0.009)	(0.008)	(0.008)	(0.008)	(0.009)	(0.009)	(0.009)
Log(Fert)	-0.092***	-0.077***	-0.079***	-0.077***	-0.091***	-0.092***	-0.091***	-0.077***	-0.078***	-0.077***
	(0.014)	(0.015)	(0.015)	(0.015)	(0.014)	(0.014)	(0.014)	(0.015)	(0.015)	(0.015)
Mig		-0.068								
		(0.049)								
Agri	0.135***	0.124**	0.112**	0.116**	0.130**	0.135***	0.135***	0.125**	0.109*	0.116**
	(0.051)	(0.057)	(0.057)	(0.057)	(0.052)	(0.052)	(0.052)	(0.057)	(0.057)	(0.057)
GFCF	-0.192***	-0.196***	-0.198***	-0.198***	-0.195***	-0.192***	-0.193***	-0.195***	-0.198***	-0.198***
	(0.034)	(0.036)	(0.036)	(0.036)	(0.034)	(0.034)	(0.034)	(0.036)	(0.036)	(0.036)
Corr	0.050	0.049	0.050	0.049	0.052*	0.050	0.051*	0.048	0.051	0.049
	(0.031)	(0.033)	(0.033)	(0.033)	(0.031)	(0.031)	(0.031)	(0.033)	(0.033)	(0.033)
Trade	0.028***	0.034***	0.036***	0.036***	0.027**	0.028**	0.028***	0.035***	0.036***	0.036***
	(0.011)	(0.012)	(0.012)	(0.012)	(0.011)	(0.011)	(0.011)	(0.012)	(0.012)	(0.012)
NetMig,L=1			0.044							
			(0.048)							
NetInMig,L=2				-0.028						-0.028
				(0.080)						(0.080)
NetOutFlow					-0.133					
					(0.098)					
NetOutMig,L=1						0.019				
						(0.096)				
NetOutMig,L=2							-0.022			
							(0.093)			
NetInFlow								-0.058		
								(0.062)		
NetInMig,L=1									0.066	
									(0.060)	
Observations	770	685	685	685	770	770	770	685	685	685
R-squared	0.876	0.871	0.871	0.871	0.876	0.876	0.876	0.871	0.871	0.871
Number of id	109	96	96	96	109	109	109	96	96	96
State FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

[a] Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.
[b] Fert represents a ,L= of 2 for log(Fertitily), Mig is the net migration share of population, Agri is the log(Agricultural Value Added), Corr is the absence of corruption and trade is the share of trade in terms of GDP
[c] For variables Q1-Q4 see Figure 1, fertCat is a categorical variable of fertility levels, OutMig is the depiction of net out-migration, where positive values take values of zero and the exact opposite goes for InMig, which encompasses positive values only and zero otherwise.
[d] columns (10)-(18) are regressions corresponding to the sub-sample of countries which are experiencing depopulation
[e] L1 represents a lag of 1 period of a variable standing before it and L2 the lag of 2 periods.

A.7: Results for all countries using HCS1 as a dependent variable for depopulation countries

VARIABLES	(1) HCI No Mig	(2) Mig	(3) Mig L1	(4) Mig L2	(5) Out Mig	(6) Out Mig L1	(7) Out Mig L2	(8) In Mig	(9) In Mig L1	(10) In Mig L2
Log(GDPperCap)	0.060***	0.025	0.020	0.020	0.063***	0.059***	0.056***	0.021	0.022	0.020
	(0.020)	(0.022)	(0.022)	(0.021)	(0.020)	(0.020)	(0.020)	(0.022)	(0.021)	(0.021)
Log(Fert)	0.010	0.038	0.026	0.027	0.024	0.008	0.007	0.028	0.027	0.027
	(0.029)	(0.031)	(0.031)	(0.031)	(0.029)	(0.029)	(0.029)	(0.031)	(0.031)	(0.031)
Mig		-0.262								
		(0.175)								
Agri	0.123	0.059	0.083	0.085	0.075	0.123	0.123	0.084	0.094	0.085
	(0.091)	(0.090)	(0.089)	(0.089)	(0.091)	(0.091)	(0.090)	(0.089)	(0.088)	(0.089)
GFCF	-0.021	0.042	0.023	0.015	0.002	-0.025	-0.035	0.027	0.024	0.015
	(0.066)	(0.067)	(0.067)	(0.067)	(0.065)	(0.066)	(0.065)	(0.067)	(0.066)	(0.067)
Corr	0.054	0.005	-0.011	-0.008	0.075	0.048	0.079	-0.008	-0.011	-0.008
	(0.049)	(0.051)	(0.052)	(0.051)	(0.049)	(0.051)	(0.050)	(0.051)	(0.051)	(0.051)
Trade	0.067***	0.093***	0.107***	0.108***	0.051**	0.068***	0.068***	0.105***	0.104***	0.108***
	(0.021)	(0.025)	(0.024)	(0.023)	(0.022)	(0.022)	(0.021)	(0.024)	(0.023)	(0.023)
NetMig,L=1			0.051							
			(0.154)							
NetInMig,L=2				-0.542						-0.542
				(0.460)						(0.460)
NetOutFlow					-0.474**					
					(0.208)					
NetOutMig,L=1						0.087				
						(0.184)				
NetOutMig,L=2							-0.310*			
							(0.166)			
NetInFlow								-0.111		
								(0.460)		
NetInMig,L=1									-0.750	
									(0.458)	
Observations	156	134	134	134	156	156	156	134	134	134
R-squared	0.934	0.940	0.939	0.940	0.937	0.934	0.936	0.939	0.941	0.940
Number of id	26	22	22	22	26	26	26	22	22	22
State FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

[a] Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.
[b] Fert represents a ,L= of 2 for log(Fertitily), Mig is the net migration share of population, Agri is the log(Agricultural Value Added), Corr is the absence of corruption and trade is the share of trade in terms of GDP
[c] For variables Q1-Q4 see Figure 1, fertCat is a categorical variable of fertility levels, OutMig is the depiction of net out-migration, where positive values take values of zero and the exact opposite goes for InMig, which encompasses positive values only and zero otherwise.
[d] columns (10)-(18) are regressions corresponding to the sub-sample of countries which are experiencing depopulation
[e] L1 represents a lag of 1 period of a variable standing before it and L2 the lag of 2 periods.

A.8: Results for all countries using HCS2 as a dependent variable for depopulation countries

VARIABLES	(1) HCI No Mig	(2) Mig	(3) Mig L1	(4) Mig L2	(5) Out Mig	(6) Out Mig L1	(7) Out Mig L2	(8) In Mig	(9) In Mig L1	(10) In Mig L2
Log(GDPperCap)	0.073***	0.034	0.030	0.031	0.076***	0.071***	0.069***	0.032	0.033	0.031
	(0.023)	(0.025)	(0.025)	(0.025)	(0.023)	(0.023)	(0.023)	(0.025)	(0.025)	(0.025)
Log(Fert)	0.017	0.044	0.035	0.038	0.030	0.014	0.013	0.036	0.037	0.038
	(0.033)	(0.037)	(0.036)	(0.036)	(0.034)	(0.034)	(0.033)	(0.036)	(0.036)	(0.036)
Mig		-0.152								
		(0.207)								
Agri	0.160	0.097	0.111	0.114	0.120	0.161	0.161	0.110	0.121	0.114
	(0.104)	(0.106)	(0.104)	(0.104)	(0.106)	(0.104)	(0.103)	(0.105)	(0.104)	(0.104)
GFCF	-0.118	-0.065	-0.080	-0.088	-0.099	-0.127*	-0.136*	-0.079	-0.075	-0.088
	(0.076)	(0.079)	(0.078)	(0.078)	(0.076)	(0.076)	(0.075)	(0.079)	(0.077)	(0.078)
Corr	0.119**	0.061	0.045	0.054	0.137**	0.108*	0.152***	0.054	0.051	0.054
	(0.056)	(0.061)	(0.061)	(0.059)	(0.057)	(0.058)	(0.058)	(0.060)	(0.060)	(0.059)
Trade	0.084***	0.116***	0.126***	0.127***	0.071***	0.086***	0.084***	0.124***	0.122***	0.127***
	(0.025)	(0.029)	(0.028)	(0.027)	(0.026)	(0.025)	(0.024)	(0.028)	(0.027)	(0.027)
NetMig,L=1			0.127							
			(0.180)							
NetInMig,L=2				-0.725						-0.725
				(0.538)						(0.538)
NetOutFlow					-0.397					
					(0.242)					
NetOutMig,L=1						0.174				
						(0.212)				
NetOutMig,L=2							-0.409**			
							(0.191)			
NetInFlow								0.210		
								(0.539)		
NetInMig,L=1									-0.681	
									(0.540)	
Observations	156	134	134	134	156	156	156	134	134	134
R-squared	0.933	0.935	0.935	0.936	0.934	0.933	0.935	0.935	0.936	0.936
Number of id	26	22	22	22	26	26	26	22	22	22
State FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

[a] Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.
[b] Fert represents a ,L= of 2 for log(Fertitily), Mig is the net migration share of population, Agri is the log(Agricultural Value Added), Corr is the absence of corruption and trade is the share of trade in terms of GDP
[c] For variables Q1-Q4 see Figure 1, fertCat is a categorical variable of fertility levels, OutMig is the depiction of net out-migration, where positive values take values of zero and the exact opposite goes for InMig, which encompasses positive values only and zero otherwise.
[d] columns (10)-(18) are regressions corresponding to the sub-sample of countries which are experiencing depopulation
[e] L1 represents a lag of 1 period of a variable standing before it and L2 the lag of 2 periods.

A.9: Results for all countries using HCS3 as a dependent variable for depopulation countries

VARIABLES	(1) HCI No Mig	(2) Mig	(3) Mig L1	(4) Mig L2	(5) Out Mig	(6) Out Mig L1	(7) Out Mig L2	(8) In Mig	(9) In Mig L1	(10) In Mig L2
Log(GDPperCap)	0.058***	0.024	0.019	0.019	0.062***	0.057***	0.055***	0.020	0.021	0.019
	(0.020)	(0.022)	(0.022)	(0.021)	(0.020)	(0.020)	(0.020)	(0.022)	(0.021)	(0.021)
Log(Fert)	0.010	0.038	0.026	0.027	0.025	0.008	0.007	0.028	0.026	0.027
	(0.029)	(0.031)	(0.031)	(0.031)	(0.029)	(0.029)	(0.029)	(0.031)	(0.031)	(0.031)
Mig		-0.263								
		(0.175)								
Agri	0.122	0.059	0.083	0.085	0.074	0.122	0.122	0.085	0.094	0.085
	(0.090)	(0.090)	(0.089)	(0.089)	(0.091)	(0.091)	(0.090)	(0.089)	(0.088)	(0.089)
GFCF	-0.020	0.042	0.022	0.014	0.003	-0.024	-0.034	0.027	0.024	0.014
	(0.066)	(0.067)	(0.067)	(0.067)	(0.065)	(0.066)	(0.065)	(0.067)	(0.066)	(0.067)
Corr	0.053	0.006	-0.010	-0.007	0.075	0.048	0.078	-0.007	-0.010	-0.007
	(0.049)	(0.051)	(0.052)	(0.051)	(0.049)	(0.050)	(0.050)	(0.051)	(0.051)	(0.051)
Trade	0.067***	0.093***	0.107***	0.108***	0.051**	0.068***	0.067***	0.105***	0.104***	0.108***
	(0.021)	(0.025)	(0.024)	(0.023)	(0.022)	(0.022)	(0.021)	(0.024)	(0.023)	(0.023)
NetMig,L=1			0.049							
			(0.154)							
NetInMig,L=2				-0.546						-0.546
				(0.460)						(0.460)
NetOutFlow					-0.474**					
					(0.207)					
NetOutMig,L=1						0.087				
						(0.184)				
NetOutMig,L=2							-0.309*			
							(0.166)			
NetInFlow								-0.116		
								(0.461)		
NetInMig,L=1									-0.758	
									(0.459)	
Observations	156	134	134	134	156	156	156	134	134	134
R-squared	0.933	0.939	0.938	0.939	0.936	0.933	0.935	0.938	0.940	0.939
Number of id	26	22	22	22	26	26	26	22	22	22
State FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

[a] Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.
[b] Fert represents a ,L= of 2 for log(Fertitily), Mig is the net migration share of population, Agri is the log(Agricultural Value Added), Corr is the absence of corruption and trade is the share of trade in terms of GDP
[c] For variables Q1-Q4 see Figure 1, fertCat is a categorical variable of fertility levels, OutMig is the depiction of net out-migration, where positive values take values of zero and the exact opposite goes for InMig, which encompasses positive values only and zero otherwise.
[d] columns (10)-(18) are regressions corresponding to the sub-sample of countries which are experiencing depopulation
[e] L1 represents a lag of 1 period of a variable standing before it and L2 the lag of 2 periods.

A.10: Results for all countries using HCS4 as a dependent variable for depopulation countries

VARIABLES	(1) HCI No Mig	(2) Mig	(3) Mig L1	(4) Mig L2	(5) Out Mig	(6) Out Mig L1	(7) Out Mig L2	(8) In Mig	(9) In Mig L1	(10) In Mig L2
Log(GDPperCap)	0.072***	0.033	0.029	0.030	0.075***	0.070***	0.067***	0.031	0.032	0.030
	(0.023)	(0.025)	(0.026)	(0.025)	(0.023)	(0.023)	(0.023)	(0.025)	(0.025)	(0.025)
Log(Fert)	0.018	0.044	0.035	0.038	0.030	0.014	0.014	0.036	0.037	0.038
	(0.033)	(0.037)	(0.036)	(0.036)	(0.034)	(0.033)	(0.033)	(0.036)	(0.036)	(0.036)
Mig		-0.154								
		(0.207)								
Agri	0.159	0.097	0.111	0.114	0.119	0.160	0.160	0.110	0.122	0.114
	(0.104)	(0.106)	(0.104)	(0.104)	(0.106)	(0.104)	(0.103)	(0.105)	(0.104)	(0.104)
GFCF	-0.118	-0.065	-0.080	-0.089	-0.098	-0.126	-0.136*	-0.080	-0.075	-0.089
	(0.075)	(0.079)	(0.078)	(0.078)	(0.076)	(0.076)	(0.075)	(0.079)	(0.077)	(0.078)
Corr	0.119**	0.062	0.046	0.055	0.137**	0.108*	0.152***	0.055	0.052	0.055
	(0.056)	(0.061)	(0.061)	(0.059)	(0.057)	(0.058)	(0.058)	(0.060)	(0.060)	(0.059)
Trade	0.084***	0.116***	0.126***	0.127***	0.070***	0.086***	0.084***	0.124***	0.122***	0.127***
	(0.025)	(0.029)	(0.028)	(0.027)	(0.026)	(0.025)	(0.024)	(0.028)	(0.027)	(0.027)
NetMig,L=1			0.125							
			(0.180)							
NetInMig,L=2				-0.728						-0.728
				(0.538)						(0.538)
NetOutFlow					-0.398					
					(0.241)					
NetOutMig,L=1						0.174				
						(0.211)				
NetOutMig,L=2							-0.408**			
							(0.190)			
NetInFlow								0.205		
								(0.539)		
NetInMig,L=1									-0.690	
									(0.540)	
Observations	156	134	134	134	156	156	156	134	134	134
R-squared	0.932	0.935	0.935	0.935	0.934	0.932	0.935	0.934	0.935	0.935
Number of id	26	22	22	22	26	26	26	22	22	22
State FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

[a] Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.
[b] Fert represents a ,L= of 2 for log(Fertitily), Mig is the net migration share of population, Agri is the log(Agricultural Value Added), Corr is the absence of corruption and trade is the share of trade in terms of GDP
[c] For variables Q1-Q4 see Figure 1, fertCat is a categorical variable of fertility levels, OutMig is the depiction of net out-migration, where positive values take values of zero and the exact opposite goes for InMig, which encompasses positive values only and zero otherwise.
[d] columns (10)-(18) are regressions corresponding to the sub-sample of countries which are experiencing depopulation
[e] L1 represents a lag of 1 period of a variable standing before it and L2 the lag of 2 periods.

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