Demographic transition and investments in children's human capital

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Abstract

The objective of this paper is to investigate the effects of the demographic transition on investment in children human capital. Using 196 Demographic and Health Surveys collected in 68 developing countries (Asian, African and Latin American countries particularly) since the 1990s, we explore the impact of the demographic conditions at childhood on child and adult outcomes. More specifically, micro-level data from the demographic and health surveys are matched with time series data on demographic conditions (fertility rate, mortality rate, dependency ratio) for each country of the sample to estimate and quantify the impact of changes in the demographic pressure at childhood on child outcomes (health and education). While our results differ across the two estimation methods used, i.e. cross-country and within country analyses, the cross-country comparisons suggest a negative association between demographic variables (fertility rate, mortality rate and dependency ratio) on human capital investments. We also find important differences across the regions with Africa being the region that suffers the most for the demographic pressure.

Keywords: Demographic dividend; demographic transition; panel; poverty; human capital; comparative analysis.

1. Introduction

The industrializing countries experienced a demographic transition during the 19th and early 20th centuries, fertility and mortality both being high at the start of the process and low at the end. Lee (2003) distinguished three phases in the demographic transition: phase 1 that is characterized by a falling mortality (infants and children mortality in particular) and hence a rising dependency ratio[1]; phase 2 that is characterized by both falling mortality and falling fertility that result in a fall in the dependency ratio, driven by the fall in the young dependency ratio; phase 3 that is characterized by a rising dependency ratio driven by rising old-age dependency.

The demographic transition, the change in population structure particularly, is expected to have positive effects on economic growth and development. Conceptualized as the demographic dividend, these potential benefits may arise through a ‘’mechanical’’ increase in the output per capita, as well as through behavioral changes (e.g. human capital investments and savings behaviors) (see Bloom et al., 2003; Eastwood and Lipton, 2011). Indeed, as the dependency ratio is decreasing and number of people willing to work is increasing, this leads to an increase in per capita production, provided that there are enough employment opportunities. This effect is amplified by rising female labor market participation and by the fact that these women are more likely to be educated. Moreover, the demographic transition (e.g. the increase in life expectancy/ the falling mortality) is supposed to trigger tremendous change in people attitudes about education, family, retirement, the role of women, etc.

As many developing countries are entering the second phase of the demographic transition[2], this could foster economic development and poverty reduction, particularly through changes in the population structure (and the mechanical increase in the output per capita), as well as through changes in human capital investments and savings behaviours.

This paper investigates the effects of the demographic transition on behavioural changes, human capital investments for instance. For countries in the early phases of the transition such as most African countries, an increase in human capital investments (education and health) is particularly important to reap the gains of the demographic transition (e.g. Bloom et. al., 2013) [3].

The theoretical literature on the links between demographic variables and human capital investments suggests two main channels through which the demographic transition may affect human capital investments. First, the literature suggests that longer life (or lower mortality rate) increases the horizon over which the returns to education can be reaped off and induce higher investment in education and health as well. Second, a decline in fertility (which is expected to be largely driven by the decline in child mortality[4]) is expected to affect parents’

[1] The dependency ratio is defined as the ratio of dependents (people younger than 15 and people older than 64) to those aged 15-64 (the working age population).

[2] See for example Reher (2004) for an analysis of the demographic transition in developed and developing countries.

[3] Although beyond the scope of this study, the role of human capital for growth offers important insights into the potential gains from the demographic transition, provided that investments in human capital are realized.

[4] Other explanations for the observed fertility decline include higher levels of income, technological progress, education, etc. (for a review of theories of demographic transition, see Galor, 2011).

investment in child's quality in accordance with the model introduced by Becker (1960) (see for example Kalemli-Ozcan, 2002, 2003; Soares, 2005).

Although the empirical evidence (from micro-and macroeconomic studies) mainly suggests a positive impact of the demographic transition on human capital investments (e.g. Jayachandran and Lleras-Muney, 2009) this link has been challenged recently by a number of papers using different demographic variables (e.g. adult mortality vs. child mortality) or methodologies.

For instance, at the macro level, Acemoglu and Johnson (2006) and Lorentzen et al. (2008) find no effect of life expectancy, respectively adult mortality, on school enrolment in cross-sectional data. These results are explained theoretically by Hazan and Zoabi (2006) who argue that, when parents choose fertility and the education of their children, a rise in life expectancy could increase not only the returns to quality (more schooling) but also the returns to quantity (more family income), mitigating the incentive to invest more in the children's education. Moreover, findings by Hazan (2012) suggest that an increase in life expectancy at birth is positively correlated with schooling whether life expectancy is taken at birth, but negatively correlated if life expectancy is taken at age 5. At the micro level, recent studies investigating the existence of a trade-off between the number of children and parents' investment in each child (quantity-quality trade-off) do not confirm the existence of the trade-off (e.g. Black et al., 2005; Angrist et al., 2010). These results reflect cross-country differences, as well as differences across time periods. They further highlight empirical challenges in estimating the effects of demographic variables on human capital investments, i.e. endogeneity issues and data limitations. For example, at the micro-level, studies on the quantity-quality trade-off must deal with the fact that parents may choose both the number of children and the level of investments in each child. Moreover, child mortality may be endogenous to child quality (for instance child health/ nutrition status).

In this study, we use panel data on 68 developing countries to examine whether demographic conditions at children' birth or year of entry to school is associated to children's health/nutrition status and school enrolment. Measured at the country level, the demographic variables (i.e. dependency ratio, fertility rate, mortality rate and life expectancy) can be reasonably considered as exogenous to parents' decisions to invest in their children. The same approach has been used in several studies including studies by Case and Paxson (2009) and Kudamatsu (2012) who investigate the impacts of country/region level variables on individual-level outcomes. Moreover, our data allow making comparisons between regions (Africa, Asia and Latin America).

We expect the demographic transition (decline in mortality and fertility rates, increase in life expectancy) to positively influence parents' investments in child's quality. In the same vein, we expect a decrease in the dependency ratio to positively influence human capital investments as it freed resources that can be reallocated to each child.

2. Data description

This paper exploits data from 196 Demographic and Health Surveys (DHS) for 68 developing countries (11 countries in Latin America, 17 in Asia and 40 in Africa) collected over the period 1990-2014 to explore the impact of demographic conditions at childhood on child outcomes. More specifically, we compile a micro-level dataset that brings together information from the DHS, and time series data on the demographic conditions (dependency ratio, fertility rate, mortality rate, life expectancy) from the World Development Indicators for each country of the sample in order to estimate and quantify the impact of changes in demographic conditions at birth or entry in primary school on child outcomes (education enrolment, health/nutrition status). Table A1 in the appendix reports the list of surveys used in the analyses by country.

The analyses are based on two samples: a sample for children aged 0-4 years born in 1985-2014 and for children aged 5-14 years born in 1976-2008. The analyses of school enrolment rely on the latter sample (children aged 5-14 years) while the analyses of health/nutrition status rely on the sample of children aged 0-4 years for whom anthropometric and health data were collected.

2.1. Health and education indicators

As usual in the literature, child's height, weight, as well as stunting (low height for age) are used as measures of child health/nutrition status. Outliers in the distribution of height and weight are recoded as missing values[5]. Education attainment is measured by a dummy variable indicated if child received a primary education. Household members were asked to report their highest level of education (no education, primary, secondary, higher).

Table 1 reports descriptive statistics on health/nutrition status and education attainment for the full sample of countries and by region.

Table 1: Descriptive statistics on school enrolment and health status of the children

	Children under 5 years				Children above 5 years
	Child weight (in kg)	**Child height (in cm)**	**Stunted**	**Wasted**	**Has no education**
All countries					
Obs	1049454	1038228	687066	677350	1887251
Mean	10.85	81.39	0.36	0.09	0.29
Std. Dev.	3.69	14.28	0.48	0.29	0.45
Asia					
Obs	213785	202355	114243	113548	488653
Mean	9.89	79.58	0.43	0.14	0.20

[5] Height below 30 cm and above 150 cm (which stand for 0.12 % of the sample); weight strictly below 1.5 and above 50 kgs (i.e. 2.44%)

Std. Dev.	3.26	13.67	0.49	0.35	0.40
Africa					
Obs	640387	641710	450255	441895	1078632
Mean	10.85	81.23	0.38	0.10	0.34
Std. Dev.	3.70	14.41	0.48	0.30	0.48
Latin America					
Obs	195282	194163	122568	121907	319966
Mean	11.92	83.83	0.23	0.02	0.24
Std. Dev.	3.80	14.13	0.42	0.15	0.42

As shown in Table 1, in average children under 5 years of age, living in the 68 countries of our sample, have 11 kg and a height of 81 cm. When we analyze the three regions separately, we note that Asiatic children have both lower height and weight relatively to children from Latin America and Africa.

Regarding the probability to achieve primary education level, one child out of five has never been to school in Asia (20.4%) and in Latin America (23.6%). This percentage reaches 34.4% in Africa what suggests a relative under investment in human capital in this region.

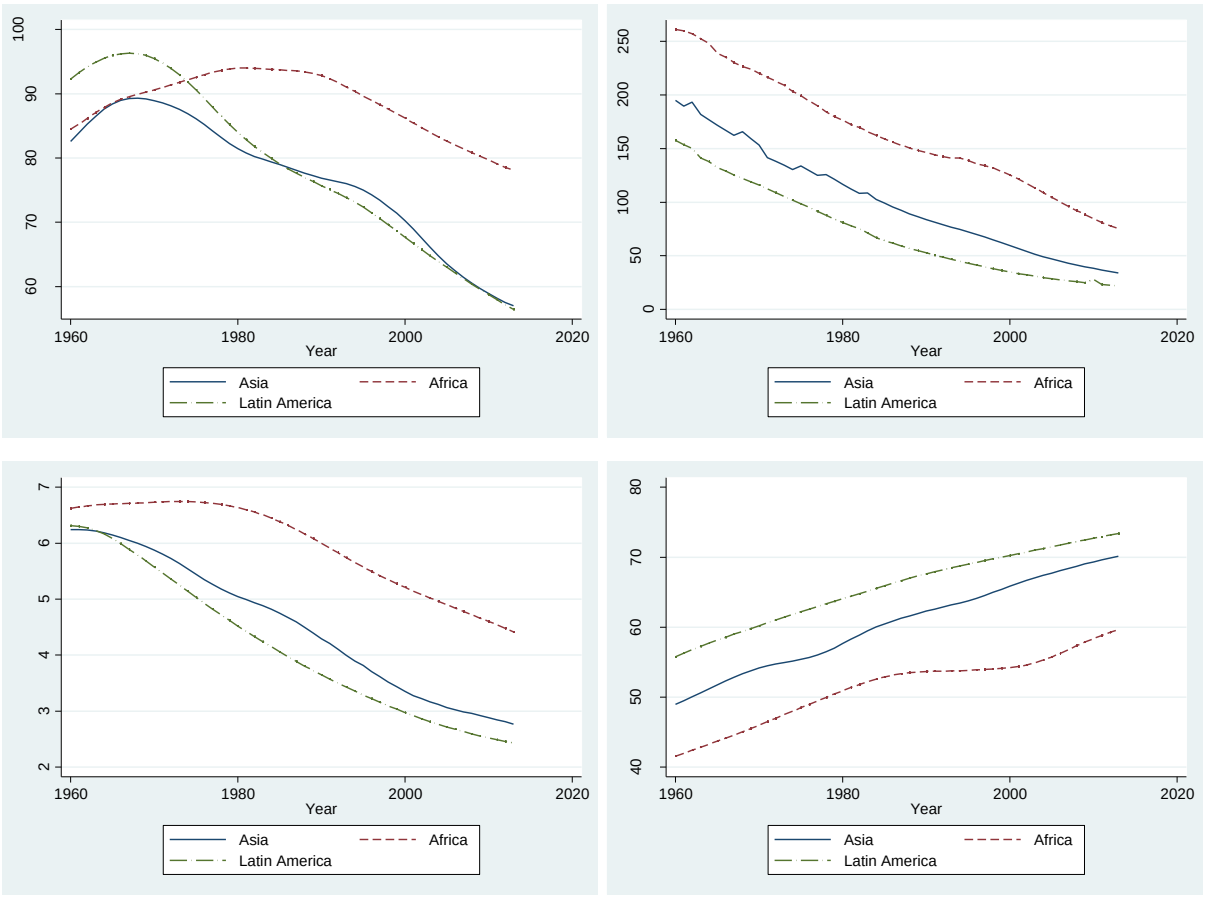
2.2. Demographic conditions

As mentioned previously, the WDI provide information on demographic variables (total dependency ratio, total fertility rate, under-five mortality rate, life expectancy at birth), as well as per capita GDP and primary school starting age by country over the period 1960-2014. This information allows constructing indicators of demographic (and economic) conditions by country at the child's birth year and at (expected) entry in primary school. See Table A2 for a description of the variables.

Figure 1 presents some descriptive statistics of the demographic variables we use by main region.

Many points can be underlined in these graphs. All the regions considered have experienced a demographic transition from 1960 to 2010 checked by the general decrease of child mortality as well as fertility rate whereas life expectancy increased. Nevertheless, as trends are parallel from one region to the other, child mortality rates in Africa remain notably higher than Asia and Latin America (75 per 1000 live births versus 30-40 in the two other regions) and life expectancy is less than 60 years in Africa but more than 70 years in the other areas.

Figure 1: Demographic conditions by continent (Asia, Africa, Latin America), 1960-2014

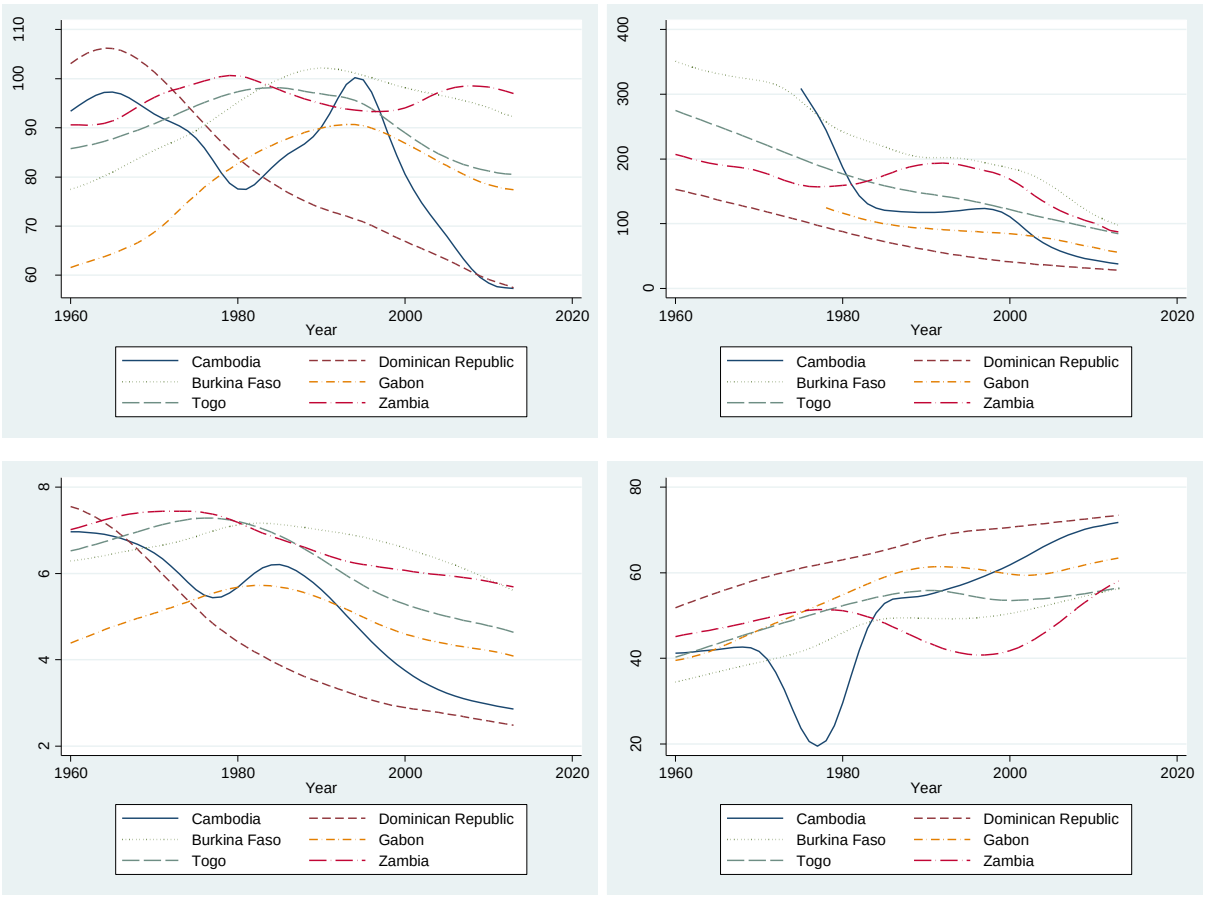


In 1960, fertility rate was between 6 and 7 children per woman in every region but its decrease until 2010 has been stronger in Asia and Latin American than in Africa. The fertility rate reaches now less than 3 children per woman except in Africa where it still stands around 4.5 children per women.

Regarding the dependency ratio, which can be interpreted as a composite indicator based on the three other measures, it follows a bell-shaped curve in each region. In Asia and Latin America, the demographic dependency ratio reaches its peak in the seventies what implies that, between 1960 and 1970, these regions were in the phase 1 of their demographic transition. This is confirmed by the stability of the fertility rate until the seventies. From 1970 to nowadays, jointly to the child mortality rate, the fertility rate has been decreasing involving the decrease of the dependency ratio. At this stage, both Asia and Latin America range in the second phase of their demographic transition without reaching yet the third phase.

Africa's dependency ratio experiences a similar evolution but more recent. In Africa, phase 2 only started in the nineties, shortly afterwards the fertility rate has been starting to decrease.

Figure 2: Demographic conditions for a sample of countries, 1960-2014



Inside each region as well, trends can be very different from one country to the other as it is shown in figure 2. Only focusing on dependency ratio, whereas Gabon, Burkina Faso or Togo for Africa present trends close from those of their respective regions in average, it is not the case for Dominican republic which is entered in the phase 2 of its demographic transition at least from 1960 and more specifically for Cambodia where political events seem to have largely disturbed all the demographic indicators.

2.3. Other individual characteristics

Tables 2 and 3 present some descriptive statistics on the main control variables used in the estimations for the full sample of countries and by region. For the sample of children under 5 years (Table 2) the average age is about 1.9 years whereas it is about 9.7 for the sample of children aged 5-14 years (Table 3). Table 3 also reveals that a great majority of the children in the sample of children aged 5-14 years received at least primary education (71 percent of the sample). This proportion varies from 66 percent in Africa to 80 percent in Asia (and 76 percent in Latin America).

For both samples, mother's age is quiet homogeneous across regions. On the opposite, mother's education differs widely from one region to the other. For instance, over the whole sample of children aged less than 5 years, the percentage of mothers who has been enrolled in

school is 63 percent, ranging from 56 percent in Africa to 87 percent in Latin America. Considering the sample of children aged 5-14 years, this proportion varies from 52 percent in Africa to 82 percent in Latin America.

Table 2 Descriptive on the main individual characteristics by region –Dataset on children under 5 years

	All countries			Asia			Africa			Latin America		
Variable	Obs.	Mean	Std. Dev.	Obs.	Mean	Std. Dev.	Obs.	Mean	Std. Dev.	Obs.	Mean	Std. Dev.
Sex (= 1 if female)	1614159	0.49	0.50	435890	0.48	0.50	940916	0.49	0.50	237353	0.49	0.50
Age (in years)	1497407	1.88	1.40	410569	1.83	1.37	860209	1.89	1.41	226629	1.98	1.41
Mother age	1614159	28.55	6.78	435890	27.97	6.35	940916	28.90	6.91	237353	28.23	6.93
Mother Relation to head (=1 if head)	1605726	0.08	0.27	435876	0.03	0.18	932508	0.09	0.29	237342	0.10	0.30
Mother Relation to head (=1 if wife)	1605726	0.68	0.47	435876	0.64	0.48	932508	0.71	0.45	237342	0.63	0.48
Mother Relation to head (=1 if daughter)	1605726	0.09	0.29	435876	0.10	0.30	932508	0.08	0.27	237342	0.15	0.36
Mother Relation to head (=1 if daughter in law)	1605726	0.09	0.28	435876	0.18	0.38	932508	0.05	0.22	237342	0.05	0.22
Mother Relation to head (=1 if other)	1605726	0.06	0.24	435876	0.05	0.21	932508	0.07	0.26	237342	0.06	0.25
Mother current marital status (=1 if never married)	1614126	0.03	0.18	435890	0.00	0.04	940894	0.04	0.20	237342	0.05	0.21
Mother current marital status (=1 if married or living together)	1614126	0.91	0.28	435890	0.98	0.15	940894	0.90	0.30	237342	0.84	0.37
Mother current marital status (=1 if widow, divorced or separated)	1614126	0.06	0.23	435890	0.02	0.15	940894	0.06	0.23	237342	0.11	0.31
Mother's education (=1 if Mother has primary, secondary or higher education level)	1614116	0.63	0.48	435880	0.68	0.47	940893	0.56	0.50	237343	0.87	0.34
Mother's education (=1 if Mother has secondary or higher education level)	1614116	0.30	0.46	435880	0.39	0.49	940893	0.23	0.42	237343	0.39	0.49
Mother weight in kg	1089009	56.15	11.97	189970	48.85	10.49	708935	57.67	11.84	190104	57.75	11.16
Mother height in cm	1088303	156.41	7.06	190099	152.25	6.10	708462	158.45	6.52	189742	153.00	6.71
Mother's Body Mass Index	1085676	22.89	4.37	189512	20.98	3.83	706698	22.94	4.32	189466	24.64	4.30

Table 3 Descriptive statistics by region –Dataset on children aged 5-14 years

	All countries			Asia			Africa			Latin America		
Variable	Obs.	Mean	Std. Dev.	Obs.	Mean	Std. Dev.	Obs.	Mean	Std. Dev.	Obs.	Mean	Std. Dev.
Sex (= 1 if female)	1748176	0.49	0.50	444307	0.49	0.50	1002269	0.49	0.50	301600	0.49	0.50
Age (in years)	1748248	9.12	2.81	444310	9.34	2.83	1002324	8.99	2.79	301614	9.25	2.83
Education (= 1 if primary/secondary/higher education)	1741907	0.69	0.46	443553	0.79	0.41	998706	0.64	0.48	299648	0.75	0.43
Education (= 1 if secondary/higher education)	1741907	0.08	0.28	443553	0.16	0.36	998706	0.05	0.23	299648	0.07	0.25
Still in school	986343	0.66	0.48	233651	0.74	0.44	481596	0.56	0.50	271096	0.75	0.43
Mother age	1748248	35.22	6.47	444310	35.15	6.17	1002324	35.25	6.59	301614	35.25	6.50
Mother Relation to head (=1 if head)	1748234	0.13	0.33	444308	0.07	0.26	1002316	0.14	0.35	301610	0.16	0.37
Mother Relation to head (=1 if wife)	1748234	0.77	0.42	444308	0.80	0.40	1002316	0.77	0.42	301610	0.74	0.44
Mother Relation to head (=1 if daughter)	1748234	0.04	0.20	444308	0.04	0.19	1002316	0.03	0.18	301610	0.07	0.25
Mother Relation to head (=1 if daughter in law)	1748234	0.03	0.18	444308	0.07	0.26	1002316	0.02	0.14	301610	0.01	0.12
Mother Relation to head (=1 if other)	1748234	0.03	0.16	444308	0.02	0.14	1002316	0.03	0.18	301610	0.02	0.15
Mother current marital status (=1 if never married)	1748229	0.01	0.10	444310	0.00	0.02	1002310	0.01	0.12	301609	0.01	0.11
Mother current marital status (=1 if married or living together)	1748229	0.91	0.29	444310	0.95	0.21	1002310	0.90	0.30	301609	0.87	0.34
Mother current marital status (=1 if widow, divorced or separated)	1748229	0.08	0.27	444310	0.05	0.21	1002310	0.08	0.28	301609	0.12	0.33
Mother's education (=1 if Mother has primary, secondary or higher education level)	1748211	0.61	0.49	444309	0.68	0.47	1002301	0.52	0.50	301601	0.82	0.39
Mother's education (=1 if Mother has secondary or higher education level)	1748211	0.25	0.43	444309	0.32	0.47	1002301	0.21	0.40	301601	0.29	0.46
Mother weight in kg	1084815	58.51	13.45	197860	52.55	12.34	695194	59.76	13.59	191761	60.12	12.29
Mother height in cm	1084275	156.55	7.06	197988	153.15	6.22	694753	158.67	6.49	191534	152.39	6.65
Mother's Body Mass Index	1081865	23.83	5.03	197531	22.30	4.57	693055	23.70	5.05	191279	25.85	4.77

3. Estimation methodology

For each child *i* born in year *t* and living in country *c* observed in the DHS, we estimate the impact of the demographic conditions at birth (entry at school) on his/her current health (educational) outcomes. The effects are estimated over a sample of about 1,600,000 children aged 5-14 years (about 1, 000, 000 children aged 0-4 years) for the education (health) outcomes through two models: a country pooled model and a country fixed-effects model. Child characteristics (age, sex), mother's and household characteristics (mother's age, education, marital status, household wealth) are also controlled for in the regressions, along with and per capita GDP at the child birth year (to control for standard of livings at birth), birth-year fixed effects and survey year fixed effects. Furthermore, the models are estimated separately for Asia, Africa and Latin America to stress the particularities of the different developing regions (see Figures 1 and 2 below).

4. Estimation results

The estimated effects of demographic variables differ across developing regions and over measures of human capital accumulation (results are summarized in Table 1). The main lessons are in order.

First, the within effect is rarely significant (when significant, it depends of the demographic variable used and the sub-sample considered) while the between effect is, suggesting that countries differ in their demography and health/education investment and that within country variation is less at stake. Second, the role of fertility rate is rarely significant in Asia while it is a significant predictor of child health outcomes in Latin America and of both education and health outcomes in Africa. Third, mortality rate is statistically significant in both Africa and Asia where its effect is negative, meaning that the higher the mortality rate, the lower are the investment in education and the health measures (height and weight controlling for age). The results also reveal that an increase in mortality risk is associated with a higher probability of stunting in Asia and Africa. Fourth, life expectancy is a good predictor of child's health in Africa and Asia.

An increase in life expectancy has a positive effect on children weight in Asia and Africa and on children height in Africa. Moreover, an increase in life expectancy significantly reduces the probability of stunting in both regions.

Regarding the effects of the dependency ratio, the results suggest that an increase in the number of dependents compared to the working age population at child's birth has a negative impact on both school enrollment and children health in Asia and Africa. These results may potentially reflect the trade-offs that exist in the allocation of family resources.

Table 3: Effects of demographic conditions on health and education, by region

	Education		Weight		Height		Stunted	
	Pooled OLS	Fixed Effects	Pooled OLS	Fixed Effects	Pooled OLS	Fixed Effects	Pooled OLS	Fixed Effects
A: Fertility rate								
All countries	-0.0381***	0.0697**	-0.0171	-0.0679	0.0227	-0.175	0.00904	0.0653**
	(0.00826)	(0.0335)	(0.0853)	(0.124)	(0.157)	(0.494)	(0.00863)	(0.0306)
Asia	-0.0153	0.0533	-0.124	-1.550**	0.150	-4.608	0.0920**	0.212
	(0.0140)	(0.0935)	(0.217)	(0.636)	(0.371)	(3.135)	(0.0346)	(0.124)
Africa	-0.0382***	0.0313	-0.371***	0.0563	-0.597***	0.544	0.0347***	0.0317
	(0.00833)	(0.0362)	(0.0369)	(0.131)	(0.115)	(0.622)	(0.00802)	(0.0439)
Latin America	-0.0351	0.0663	-0.250***	-0.990	-1.398***	-6.561	0.0271	0.235
	(0.0458)	(0.172)	(0.0678)	(1.015)	(0.259)	(5.138)	(0.0793)	(0.167)
B: Mortality rate								
All countries	-0.00107***	-0.000796*	-0.00314*	-0.00224	-0.00434	-0.00443	0.000429*	-0.000900***
	(0.000235)	(0.000469)	(0.00174)	(0.00141)	(0.00360)	(0.00564)	(0.000236)	(0.000318)
Asia	-0.00214*	-0.00152	-0.0219***	-0.0423	-0.0484***	-0.108	0.00248***	0.00560**
	(0.00118)	(0.00324)	(0.00482)	(0.0352)	(0.00854)	(0.116)	(0.000362)	(0.00214)
Africa	-0.000759***	-0.000512	-0.00675***	-0.00110	-0.0131***	-0.00413	0.000870***	0.00191***
	(0.000220)	(0.000485)	(0.00128)	(0.00126)	(0.00271)	(0.00538)	(0.000202)	(0.000594)
Latin America	-0.000605	0.00126	-0.00129	0.00804	0.00713	0.0236	0.000350	0.00121***
	(0.000655)	(0.00155)	(0.00246)	(0.00457)	(0.00996)	(0.0197)	(0.000585)	(0.000325)

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	Education		Weight		Height		Stunted	
	Pooled OLS	Fixed Effects	Pooled OLS	Fixed Effects	Pooled OLS	Fixed Effects	Pooled OLS	Fixed Effects
C: Life expectancy								
All countries	0.00441***	0.00160	0.00913	0.0289***	0.0163	0.0819**	-0.00264**	-0.00689**
	(0.00144)	(0.00315)	(0.0128)	(0.00773)	(0.0244)	(0.0318)	(0.00120)	(0.00287)
Asia	0.000372	-0.00230	0.110*	0.290**	0.120	0.853	-0.0253**	-0.0781**
	(0.00718)	(0.0201)	(0.0584)	(0.129)	(0.131)	(0.566)	(0.00885)	(0.0258)
Africa	0.00169	0.000576	0.0342***	0.0137*	0.0724***	0.0410*	-0.00509***	-0.00763**
	(0.00132)	(0.00322)	(0.0100)	(0.00702)	(0.0196)	(0.0230)	(0.000840)	(0.00286)
Latin America	0.00666	-0.116*	0.0308*	0.179	-0.0196	0.952	0.00707	-0.00871
	(0.00402)	(0.0527)	(0.0155)	(0.147)	(0.0478)	(0.792)	(0.00721)	(0.0490)
D: Dependency ratio								
All countries	-0.00329***	0.00447**	0.00361	0.00181	0.0109	-0.00571	0.000485	-0.00109
	(0.000853)	(0.00169)	(0.00818)	(0.00898)	(0.0147)	(0.0312)	(0.000833)	(0.00180)
Asia	2.69e-05	0.00127	0.00849	-0.0596**	0.0325*	-0.180	0.00124	-0.000374
	(0.00213)	(0.00661)	(0.00831)	(0.0273)	(0.0179)	(0.135)	(0.00212)	(0.00811)
Africa	-0.00249***	0.00333*	-0.0332***	0.0102	-0.0500***	0.0348	0.00316***	-0.00677**
	(0.000908)	(0.00187)	(0.00566)	(0.00882)	(0.0115)	(0.0326)	(0.000822)	(0.00282)
Latin America	-0.00302	0.0153	-0.0202**	-0.0205	-0.0920***	-0.186	0.00118	0.0177*
	(0.00335)	(0.0123)	(0.00767)	(0.0614)	(0.0206)	(0.310)	(0.00316)	(0.00755)

Note: Only estimated coefficients and standard errors of the variables of interest are reported. A complete version of the estimation results can be found in the report. Robust standard errors are in parenthesis. *, **, *** for a significance at 10, 5 and 1% respectively.

6. Conclusion

In this paper, we estimated the effects of demographic conditions at birth on children health status and educational attainment using a large dataset including 68 developing countries and covering a long time period.

Our results raise the issue of the mechanisms through which the demographic transition, fertility and mortality declines particularly, affect human capital investments. This work contributes to the literature on the links between demography and investments and the literature on the demographic dividend.

The results suggest that less demographic pressure coming from the rising number of surviving adults able to financially support the dependent people raises the demand for school enrolment and child health status. Furthermore, the results show important differences between the regions of the World suggesting that Asian and African countries could particularly benefit from the reductions of mortality and fertility rates. The differences between the effects of the demographic variables considered in the analyses also highlight the different mechanisms that link the demographic transition to human capital investments. For instance, the results suggest that pressure on resources plays an important role in explaining the differences in human capital investments across African and Asian countries. This result calls for the policies aiming at creating employment opportunities along with policies favoring mortality and fertility declines.

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Appendix

Table A1: list of Demographic and Health Surveys used in the analyses

Country	Survey years		
	Sample 1: Adult	Sample 2: Under 5 children	Sample 3: Above 5 children
African countries			
Benin	1996, 2001, 2006, 2012	1996, 2001, 2006, 2012	1996, 2001, 2006, 2012
Burkina Faso	1993, 1999, 2003, 2010	1993, 1999, 2003, 2010	1993, 2003, 2010
Burundi	1987, 2010	2010	2010
Cameroon	1991, 1998, 2004, 2011	1991, 1998, 2004, 2011	1991, 1998, 2004, 2011
Central African Republic	1994	1994	1994
Chad	1997, 2004	1997, 2004	1997, 2004
Comoros	1996, 2012	1996, 2012	1996, 2012
Congo. Dem. Rep.	2007, 2013	2007, 2013	2007, 2013
Congo. Rep.	2005, 2011	2005, 2011	2005, 2011
Cote d'Ivoire	1994, 1998, 2012	1994, 1998, 2012	1994, 2012
Egypt. Arab Rep.	1988, 1992, 1995, 2000, 2005, 2008, 2014	1992, 1995, 2000, 2005, 2008, 2014	2000, 2008, 2014
Ethiopia	2000, 2005, 2011	2000, 2005, 2011	2000, 2005, 2011
Gabon	2000, 2012	2000, 2012	2000, 2012
Gambia. The	2013	2013	2013
Ghana	1988, 1993, 1998, 2003, 2008	1993, 1998, 2003, 2008	1993, 1998, 2003, 2008
Guinea	1999, 2005, 2012	1999, 2005, 2012	1999, 2005, 2012
Jordan	1990, 1997, 2002, 2007, 2012	1990, 1997, 2002, 2007, 2012	1997, 2002, 2007, 2012
Kenya	1989, 1993, 1998, 2003, 2008	1993, 1998, 2003, 2008	1993, 1998, 2003
Lesotho	2004, 2009	2004, 2009	2004, 2009
Liberia	1986, 2007, 2013	2007, 2013	2007, 2013
Madagascar	1992, 1997, 2004, 2009	1992, 1997, 2004, 2009	1992, 1997, 2004, 2009
Malawi	1992, 2000, 2004, 2010	1992, 2000, 2004, 2010	1992, 2000, 2004, 2010
Mali	1987, 1996, 2001, 2006, 2012	1996, 2001, 2006, 2012	, 1996, 2001, 2012
Morocco	1987, 1992, 2003	1992, 2003	1992
Mozambique	1997, 2003, 2011	1997, 2003, 2011	1997, 2003, 2011
Namibia	1992, 2000, 2007, 2013	1992, 2000, 2007, 2013	1992, 2000, 2007, 2013
Niger	1992, 1998, 2006, 2012	1992, 1998, 2006, 2012	1992, 1998, 2006, 2012
Nigeria	1990, 2003, 2008, 2013	1990, 2003, 2008, 2013	1990, 2003, 2008, 2013
Rwanda	1992, 2000, 2005, 2010	1992, 2000, 2005, 2010	2000, 2005, 2010
Sao Tome and Principe	2008	2008	2008
Senegal	1986, 1993, 1997, 2005, 2011	1993, 1997, 2005, 2011	1993, 2005, 2011
Sierra Leone	2008, 2013	2008, 2013	2008, 2013
South Africa	1998	1998	1998
Sudan	1990		

Swaziland	2006	2006	2006
Tanzania	1991, 1996, 1999, 2004, 2010	1991, 1996, 1999, 2004, 2010	1991, 1996, 1999, 2004, 2010
Togo	1988, 1998, 2013	1998, 2013	1998, 2013
Tunisia	1988		
Uganda	1988, 1995, 2000, 2006, 2011	1995, 2000, 2006, 2011	1995, 2000, 2006, 2011
Yemen. Rep.	1991	1991	1991
Zambia	1992, 1996, 2002, 2007, 2013	1992, 1996, 2002, 2007, 2013	1992, 1996, 2002, 2007, 2013
Zimbabwe	1988, 1994, 1999, 2005, 2010	1994, 1999, 2005, 2010	1994, 1999, 2005, 2010
Asian countries			
Azerbaijan	2006	2006	2006
Bangladesh	1994, 1997, 2000, 2004, 2007, 2011	1994, 1997, 2000, 2004, 2007, 2011	
Cambodia	2000, 2005, 2010	2000, 2005, 2010	2000, 2005, 2010
India	1993, 1999, 2006	1993, 1999, 2006	2006
Indonesia	1987, 1991, 1994, 1997, 2003, 2007, 2012	1991, 1994, 1997, 2003, 2007, 2012	1991, 1994, 1997, 2003, 2007
Kazakhstan	1995, 1999	1995, 1999	1995, 1999
Kyrgyz Republic	1997, 2012	1997, 2012	1997, 2012
Maldives	2009	2009	2009
Nepal	1996, 2001, 2006, 2011	1996, 2001, 2006, 2011	2006, 2011
Pakistan	1991, 2006, 2012	1991, 2006, 2012	1991, 2012
Philippines	1993, 1998, 2003, 2008, 2013	1993, 1998, 2003, 2008, 2013	1993
Sri Lanka	1987		
Tajikistan	2012	2012	2012
Thailand	1987		
Timor-Leste	2009	2009	2009
Turkey	1993, 1998, 2003	1993, 1998, 2003	1993, 1998, 2003
Ukraine	2007	2007	2007
Uzbekistan	1996	1996	1996
Vietnam	1997, 2002	1997, 2002	
Latin American countries			
Bolivia	1989, 1994, 1998, 2003, 2008	1994, 1998, 2003, 2008	1998, 2003, 2008
Brazil	1986, 1991, 1996	1991, 1996	1991, 1996
Colombia	1986, 1990, 1995, 2000, 2005, 2010	1990, 1995, 2000, 2005, 2010	1990, 1995, 2000, 2005, 2010
Dominican Republic	1986, 1991, 1996, 1999, 2002, 2007, 2013	1991, 1996, 1999, 2002, 2007, 2013	1991, 1999, 2002, 2007, 2013
Ecuador	1987		
El Salvador	1985		
Guatemala	1987, 1995	1995	1995
Guyana	2009	2009	2009
Haiti	1994, 2000, 2006, 2012	1994, 2000, 2006, 2012	1994, 2000, 2006, 2012
Honduras	2006, 2012	2006, 2012	2006, 2012
Mexico	1987		

Nicaragua	1998, 2001	1998, 2001	1998, 2001
Paraguay	1990	1990	1990
Peru	1986, 1991, 1996, 2000	1991, 1996, 2000	1996, 2000
Trinidad and Tobago	1987		
Total	*76 countries, 222 surveys*	*68 countries, 196 surveys*	*66 countries, 164 surveys*

Table A2 : Description of variables

Variable	Description
***Country-level variables (source: World Development Indicators 2014*)**	
Age dependency ratio (% of working-age population)	Age dependency ratio is the ratio of dependents--people younger than 15 or older than 64--to the working-age population--those ages 15-64. Data are shown as the proportion of dependents per 100 working-age population.
Age dependency ratio, old (% of working-age population)	Age dependency ratio, old, is the ratio of older dependents--people older than 64--to the working-age population--those ages 15-64.
Age dependency ratio, young (% of working-age population)	Age dependency ratio, young, is the ratio of younger dependents--people younger than 15--to the working-age population--those ages 15-64.
Fertility rate, total (births per woman)	Total fertility rate represents the number of children that would be born to a woman if she were to live to the end of her childbearing years and bear children in accordance with current age-specific fertility rates.
Mortality rate, under-5 (per 1,000 live births)	Under-five mortality rate is the probability per 1,000 that a newborn baby will die before reaching age five, if subject to age-specific mortality rates of the specified year.
Life expectancy at birth, total (years)	Life expectancy at birth indicates the number of years a newborn infant would live if prevailing patterns of mortality at the time of its birth were to stay the same throughout its life.
Primary school starting age (years)	Entrance age of primary is the age at which students would enter primary education, assuming they had started at the official entrance age for the lowest level of education, had studied full-time throughout and had progressed through the system without repeating or skipping a grade.
GDP per capita (constant 2005 US$)	GDP per capita is gross domestic product divided by midyear population. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Data are in constant 2005 U.S. dollars.
Household/individual level data (Data source: demographic and Health surveys)	
Wasting*	Moderate and severe - below minus two standard deviations from median weight for height of reference population.
Stunting*	Moderate and severe - below minus two standard deviations from median height for age of reference population;
Household wealth (wealth index)	The wealth index is a composite measure of a household's cumulative living standard. The wealth index is calculated using data on household's ownership of selected assets, such as televisions and bicycles; materials used for housing construction; and types of water access and sanitation facilities.

* Indicators constructed using data on child's weight, height and age collected in DHS.