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ECONOMIC DEVELOPMENT AND POPULATION GROWTH: AN INVERTED-U SHAPED CURVE?

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Economic development and population growth: an inverted-U shaped curve?

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Abstract

There has been a large debate on the relations between demography and economic development. Our paper discusses the possibility that there exists an inverted-U curve, similar in shape to Kuznets's curve, between the growth rate of population and the growth rate of the per-capita GDP. The cross-country empirical analysis, carried out on over 90 countries in the period 1980-2010, seems to confirm the existence of this kind of curve. The main reasons behind this phenomenon are discussed. First, it is difficult to sustain a high economic growth either with a low (lower than 0.5%) or high (higher than 2-2.5%) growth rate of population. In the first case, an excessive ageing of population causes the well-known negative consequences. In the second case, the possibilities of large households of providing children with adequate nourishment, education and health are reduced. Moreover, without a perfect capital market, it is difficult to promote new firms and innovation unless adequate personal or family resources are available.

1. Introduction

The aim of this paper is to revisit the relation between population growth and economic development starting from the observation that in the period 1980-2010, using cross-country data, the relation seems to exhibit an inverted-U shaped form. This form, similar to the one utilized in various versions of Kuznets' curve[1], led us to assume that several low-income countries, which usually have a high rate of growth of population, have encountered great problems breaking the vicious circles of poverty and establishing a good pattern of economic growth. On the other hand in several mature countries, where population growth is close to zero or even negative, economic development tends to be very slow.

In this paper we try to discuss the main determinants of these complex relationships and to wonder whether there is an intermediate zone in which the rate of growth of population is likely to be associated with a higher rate of economic growth.

2. Demography and economic growth

Francesco Botero in his *Delle cause della grandezza delle città* (1558) was probably the first major author systematically treating of the limits of population growth in urban areas and the economy. However his contribution was almost completely overlooked in the prevailing economic literature[2]. Most analyses on the relations between population growth and economic development start from the seminal contribution of Malthus. Malthus is generally considered to have introduced malthusianism, an utterly pessimistic view on the relationship between population growth and economic development. However, while in 1798 's edition of his "Essay on population"[3] his conclusions were indeed very pessimistic, in his 1803 enlarged edition of the "Essay" they were somewhat softer and in his 1820 "Principles of Political Economy" Malthus held a much more optimistic view[4].In his 1798 contribution Malthus maintained that resources are limited and land has diminishing returns so that an increase of income will determine a rise in population, which will lead to starvation, deaths and population decline until a new equilibrium will be restored. In the "Principles" Malthus recognized instead the importance of technical progress in agriculture and of fertility restraint. He also introduced, in the short run, the possibility of increasing in some occasions effective demand thereby rising overall production, anticipating for some aspects the analysis of Keynes.

Malthusianism was more or less influential for over a century, but many authors criticized several parts of Malthus' arguments in the first edition of the "Essay". In particular his assertion that population will grow at a geometric rate while food will grow at an arithmetic rate was found empirically wrong. Technical progress in agricultural and industrial production, some restraints in fertility and, in some occasions, emigration to America or Australia made possible the persistence of a delicate balance between population rise and economic growth even in a supposedly overcrowded Europe. Moreover, the history of industrialized countries in the XIX and XX century revealed that beyond a certain level of development, health and hygiene progress, industrialization, urbanization, the rise of

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[1] The original Kuznets curve associates income inequality and per capita income and the "environmental Kuznets curve", associates some pollution indicator and per capita income. Notice that our inverted U shaped curve differs from Kuznets curves both for the variables used and for the positions on the axes.

[2] One notable exception is Perlman (1975), p. 248, in his contribution to a Symposium on Population in the "Quarterly Journal of Economics".

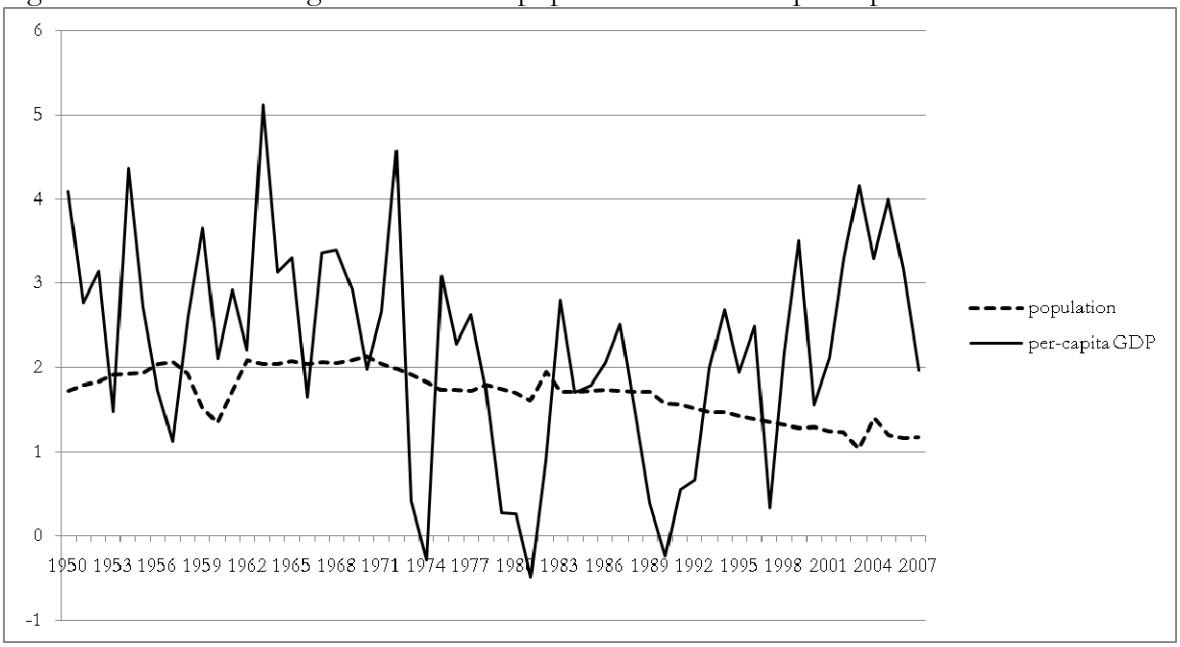
3 See Malthus (1798).

[4] On the two Malthus, the malthusian author of the"Essay" and the "economist" of the" Principles", see for example, Spengler (1957), Paglin (1964), Barucci (1972), pp XXVI-XXVII.

education and in particular of female education, the increase in the cost of rising children and in some case, change in values and family planning policies tend to determine a "demographic transition", namely a passage from high birth and death rates to low birth and death rates, that finally can lead to a progressive decline in population growth[5]. As graph 1 and table 1 and 2 show, there has been in the long run a sharp acceleration of the rate of growth of world population and then a gradual decline, at first in industrialized countries and more recently in several emerging and developing countries.

While in Malthus approach population was endogenous in his economic development view, most growth studies of the 1930s and the 1940s, as Harrod's and Domar's models assumed population as an exogenous variable. Leibenstein tried to show the risks of this approach, emphasizing the complex interrelationships between economic development and population trends[6]. He argued that poor countries had to make a "critical minimum effort" in order to be able to break the vicious circles of poverty and to reach a sustainable rate of economic growth capable of reducing the motivations to have large families typical of most poor subsistence economies.

Figure 1. Annual rate of growth of world population and world per-capita GDP: 1950- 2008.



Source: Maddison (2010).

[5] See, for example, Thompson (1929), Notenstein (1945), United Nations (1953). A recent contribution (Myrskyla, Kohler and Bollari, 2009) has introduced the possibility that beyond a certain very high level of the human development index (HDI) the decreasing trend of the fertility rate will reverse.
[6] See Leibenstein (1954), (1957), chapters 8 and 10, and (1975).

Table 1. Average annual rates of growth of population in main countries and regions: 1913-2030

Areas or countries	**1913-50**	**1950-73**	**1973-2003**	**2003-2030***
World	*0.93*	*1.93*	*1.59*	*0.98*
Western Europe	0.42	0.71	0.32	0.05
US	1.21	1.45	1.06	0.84
Eastern Europe	0.26	1.01	0.32	- 0.21
Former USSR	0.38	1.44	0.47	0.27
Latin America	1.96	2.72	1.90	0.97
Japan	1.32	1.14	0.53	-0.33
China	0.61	2.10	1.27	0.46
India	0.45	2.11	2.00	1.12
Total Asia (escl. Giappone)	0.92	2.19	1.76	0.95
Africa	1.65	2.36	2.64	1.98

* Forecasts. Source: Maddison (2007), pp. 377 and 336.

Table 2. Rates of growth of per capita GDP in main countries and regions: 1950-2030

Areas or countries	**1913-50**	**1950-73**	**1973-2003**	**2003-2030***
World	*0.88*	*2.91*	*1.56*	*2.2*
Western Europe	0.76	4.05	1.87	1.7
US	1.61	2.45	1.86	1.7
Eastern Europe	0.60	3.81	0.87	2.0
Former USSR	1.76	3.35	- 0.38	
Latin America	1.41	2.60	0.83	1.5
Japan	0.88	8.06	2.08	1.3
China	-0.56	2.76	5.99	4.5
India	-0,22	1.40	3.14	4.5
Total Asia (excl. Japan)	-0.08	2.87	3.88	
Africa	0.91	2.02	0.32	1.0

* Forecasts. Source: Maddison (2007), pp. 382 and 337.

However, in the late 1950s several scholarly studies such as an influential book by Coale and Hoover (1958)[7] re-introduced the possible existence of a negative relationship between population growth and economic development in low-income countries. Very large families, as the ones prevailing in India in those years, would lead to lower national saving and investment rates. Moreover the higher expenditure on education and health required by the rapidly growing population would reduce the financial resources available for productive investment. While the book had an important impact on academic debate and policies, it was not confirmed by several empirical studies. Moreover, it badly overlooked the importance of human capital and technical progress on economic development[8], which the new growth theories came to emphasize.

[7] See Coale, Hoover (1958)

[8] See for these critical remarks Kelley (2001), p. 5. See also for other good surveys Kelley (1988), Kelley, Schmidt (2005), Lee (2009).

In the 1960s also influential popular pamphlets, such as Paul and Anne Ehrlich's book "Population bomb" (1968), were supporting neo- malthusian pessimistic views about the consequences of the rapid world population growth. Not only such a fast growth of population, mainly due to the substantial reduction of mortality in developing countries, could lead to starvation and death for large masses of population, but also it could contribute to badly deteriorate the world environment and to exhaust several limited natural resources. Here again academic debate and history revealed that most of authors' forecasts were wrong and their worries about a global lack of food were largely exaggerated, although severe damages on environment have become more and more evident.

Also the celebrated, and widely discussed, Club di Roma contribution of MIT scientists "Limits to growth" (1972) held a pessimistic view on the relations between high population growth, limited natural resources, and the economic growth pattern prevailing in the world, but several economists criticized the rather rigid assumptions of the MIT model, although many authors acknowledged the existence of severe and growing risks for global environment.

As Figure 1 and table 1 show, in the second part of the XX° Century and in the first decade of this Century there has indeed been an explosive growth of world population, but there has also been, a substantial acceleration of economic growth and, since 1972, a gradual, but steady decline of the rate of growth of world population. Economic growth was also accompanied by a certain increase in per capita availability of food. It is, however, true that even now large masses of population, mainly concentrated in developing countries are under-nourished and suffer of hunger and severe deprivation of basic needs, because food and the benefits of growth have been unevenly spread between countries and among families and regions.

As the academic debate is concerned, in the 1970s some influential authors, such as Simon Kuznets (1973), Boserup (1976) and Perlman (1975) raised some doubts on the theoretical and empirical bases of the pessimistic view. While the (US) Commission on Population Growth and the American Future (1972-3) held in its conclusions the traditional pessimistic anti-natalistic and anti-migration view, a UN 1973 report concluded in a much less pessimistic way, stating that the rise of population led to both negative and positive effects and that some price and institutional feedbacks might partly compensate the impact of negative effects.

A stronger reaction to the pessimistic view came through the contributions by Boserup (1965), (1976), (1981) and Simon (1981). The former emphasized the fact the many technological advances in agriculture were made when population pressure determined high land densities. As Kelley has noted "Simon extended this notion to observe that major social overhead projects (roads, communication, irrigation) benefitted from expanded population and scale"[9]. Moreover he illustrated the importance of population pressures on various forms of long –run "feedbacks", as price induced substitutions in the use of natural resources, as well as the role of density and size of population. Simon concluded that population growth could have a net positive effect on economic growth in developing countries. His optimistic view heavily influenced the economic debate in the 1980s. Many contributions led to a more balanced view if compared with the traditional pessimistic one[10]. Although it was maintained that slower population growth might contribute to economic growth of many developing countries, its quantitative impact was considered weak and much attention was given to country-specific factors.

From an empirical point of view, the Nineties marked a turning point in the econometric techniques and specifications used to investigate the relationship between demography and economic growth. In particular, it reflected the necessity to explain the diverging results of empirical analyses carried out over

[9] See Kelley (2001), p. 10

[10] See National Research Council (1986), Birdsall (1988), Kelley (1988), Srinivasan (1988).

the previous 30 years. While in the 1960s and 1970s the correlation between population growth and per-capita GDP growth was found weak and statistically insignificant, in the 1980s the empirical evidence showed a negative relation between the two variables (see Kelley 2000 and Lee 2009). As a consequence, in the 1990s the empirical efforts aimed at better formulating the theoretical framework and going beyond the simple correlation between population growth and economic growth.

Moreover, the world was rapidly changing. As pointed out in the Report of the UN International Conference on Population and Development (ICPD), held in Cairo in 1994, "the decline in fertility levels, reinforced by continued declines in mortality levels, is producing fundamental changes in the age structure of the population of most societies. […] The majority of the world's countries are converging towards a pattern of low birth and death rates, but since those countries are proceeding at different speeds, the emerging picture is that of a world facing increasingly diverse demographic situations" (UN 1995, pp. 32 and 53). However, "despite recent declines in birth rates in many countries, further large increases in population size are inevitable" (UN 1995, p.15). One of the core issue emerging from the UN ICPD was the awareness that what determines the demographic effect on development and economic growth is the structure rather than the growth rate of population, recognizing that each country should integrate demographic issues into economic and development strategies according to its population composition.

These academic and historical changes gave rise to two main directions of research, often overlapping[11]. First, the new convergence models inspired by Barro's pioneering work (Barro 1997) took into account short and long run impact of demography on economic growth and the possibility of reversing effects. Second, the total population growth rate was split and decomposed into fertility and mortality components or into different age-cohorts (Barro and Lee 1994; Barlow 1994; Brander and Dowrick 1994; Kelley and Schmidt 1995 and 2005, Barro 1997; Bloom and Williamson 1998; Azomahou and Mishra 2008). Barro (1997) found a long-run positive effect of a decreasing fertility rate, while Kelley and Schmidt (1995) provided evidence for reversing effects of birth-rate reductions, promoting economic growth in the short run and affecting it in the long run. From then on, the main idea has been that what affects economic growth is the change in the working-age population rather than the total population growth. In other words, what matters is the evolution in the age composition of population.

In general, what emerged from these studies is that fertility rate has a negative and significant impact on economic growth in the short period. This acts by increasing the share of unproductive population. However, in the long period a greater share of population will enter the productive working force, fostering economic growth. Countries in which working-age population is swelling could indeed benefit from the so-called "demographic dividend", i.e. the increase in the added productivity leading by the maturing of formerly young population (Bloom, Canning and Sevilla 2001).

An important theorization of this perspective was provided by Bloom and Williamson (1998) and further developed by Bloom, Canning and Sevilla (2001), Bloom, Canning and Finlay (2008) and Cervellati and Sunde (2009). These studies modeled the impact of the working-age population growth and individuated three channels by which age-structured population and the relative economic behavior can affect economic growth. The first relies on the endowment of labor inputs per-person, defined as the working hours per-capita and depending on the working-age population share. The second is based on different saving behavior across age cohorts: the young and the elderly are used to save less, while people aged between 40 and 65 save more. Third, investment in human capital change along with the life expectancy. When life expectancy improves, educational investment should increase and then the labor force productivity. Bloom and Williamson (1998) empirically tested and confirmed the

[11] Along with these macro-studies, it is worth mentioning an important series of micro-analyses aiming to explain family behavior in terms of fertility (see Lee 2009 for a review) .

theoretical hypothesis according to which age distribution rather than overall population growth affects economic growth. A full demographic transition could require more than 50 years and is characterized by three phases. At first, young cohorts swell and decelerate economic growth; then, after around 20 years, these cohorts become active and productive, promoting economic growth; finally, they become elderly and their dependency burden limits economic growth again.

Recently, this logical framework was further tested by Choudhry and Elhorst (2010). Using data from 70 countries over the period 1961-2003 and alternative econometric specifications, authors regressed the GDP per-capita growth rate on three demographical variables: the growth differential between working-age and total population, the child dependency ratio and the old-dependency ratio. Results confirm that the increasing relative importance of working-age population has a positive impact on economic growth, while a high child dependency ratio hinders the growth rate. Conversely, the effect of the old-cohorts is ambiguous and not significant, confirming the findings of Bloom et al. (2008). However, these results could reflect the composition of the sample, under-representing countries that have completed the demographic transition. This suggest that empirical and theoretical analyses should deeply investigate the effects of demographic variables by disjointing factors differently acting in young and mature countries.

Our contribution is twofold. On the one hand, we explore the possibility of quadratic effects. The hypothesis we test is that growth rates are negatively affected both by low and high growth rates of population. In other words, we aim to understand if there exists a range of population growth favorable to the economic growth. On the other hand, we discuss the effects of population growth dividing countries in three categories: young poor, vibrant emerging and ageing mature countries.

3. An empirical assessment: does there exist an inverted-U shaped curve?

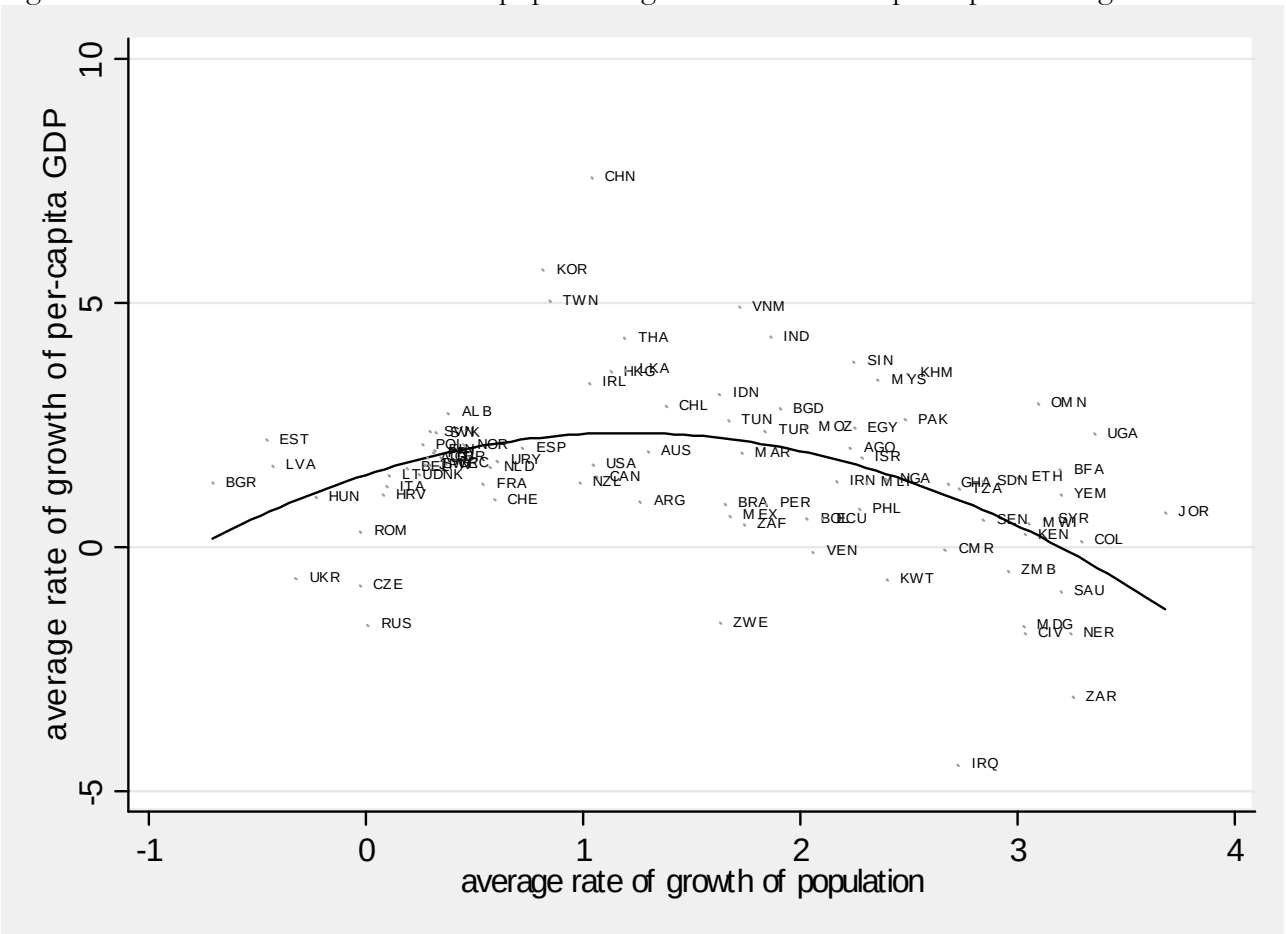
Our cross-country analysis covers a sample of 93 countries over the period 1980-2010[12]. We regress the average annual growth rate of per-capita GDP for the period 1980-2010 on five main variables: the average annual growth rate of population for the same period and its squared, the average young-age-dependency ratio and the average young-old-dependency ratio over the analyzed period and the average annual growth rate of educational attainment. The square of the average annual growth rate of population is introduced to take into account the possibility of non-linear effects. To test the effects of age-cohorts depending on the working-age population, we use the total-age-dependency ratio and, alternatively, we split it into its young and old components. The annual growth rate of educational attainment is included to typify two potential effects. First, as well known, it could have a direct effect on the per-capita GDP growth as a proxy for human capital. Second, it is a proxy for the average age of entrance in the labor market. Indeed, the more young people study, the later they enter the work-force unless they work and study at the same time. Actually, this effect would be better captured by the activity and employment rates by age-cohorts. However, this is unfeasible because of the lack of reliable cross-country data for the full set of countries. Data on per-capita GDP and population are based on the Total Economy Database provided by Groningen Growth and Development Centre (GGDC), while the age-dependency ratios are taken from the World Development Indicators (WB). Educational attainment data are from the Barro-Lee dataset (2010) and refer to population aged 15 and over.

Results are shown in table 3 and validate our hypothesis. The average annual growth rate of population and its squared are significant and of opposite sign, the former positive and the latter negative. This suggests that countries with either low (lower than 0.5%) or high population growth rates (higher than 2-2.5%) are characterized by a lower pace of economic development. In other words, it seems that there exists a inverted-U curve representing the empirical relationship between economic and

[12] Countries with a population lower than 1 million are excluded from the sample.

population growth. This is shown in figure 2, in which the two average annual rates of growth are plotted by country. The interpolation line is based on the results reported in table 3, column 1. Mechanisms behind this relationship are discussed in the next section.

Figure 2. Inverted-U curve between the population growth rate and the per-capita GDP growth rate.



The importance of the ratio between depending and working-age population is confirmed. The coefficients of total-age-dependency ratio and its two old and young components are significant and negative. However, it seems that countries presenting a high average old-dependency ratio over the period 1980-2010 have been more penalized in terms of economic growth than countries with a high young dependency ratio. On the contrary, the effect of the educational attainment growth is not significant although of the expected sign.

Our findings suggest that the equation better representing the relationship between economic growth and population growth has the following form. We discuss it in the next section.

$$tPCGDP = 4.85 + 1.02tPOP - 0.42tPOP^2 - 0.05depYOUNG - 0.10depOLD \quad [1]$$

.

Table 3. OLS regression results

Dependent variable: average annual growth rate of per-capita GDP (1980-2010)

	(1)	(2)	(3)	(4)	(5)	(6)
pop (aagr)	1.4292**** (3.1100)	0.3143 (1.1400)	1.5924**** (3.4700)	1.6080**** (3.5100)	1.0188* (1.7300)	1.1750* (1.9800)
dependency ratio		-0.0493**** (-2.9200)	-0.0333** (-2.0000)	-0.0436** (-2.3200)		
pop-squared (aagr)	-0.5918**** (-4.1500)		-0.4905**** (-3.3900)	-0.5192**** (-3.4700)	-0.4167**** (-2.7500)	-0.4638**** (-2.9600)
dependency ratio young					-0.0375** (-2.2300)	-0.0455*** (-2.4200)
dependency ratio old					-0.1135** (-2.0600)	-0.1035* (-1.8600)
average education (aagr)				0.2494 (1.5400)		0.2172 (1.3300)
constant		4.2674**** (5.1900)	3.0484**** (3.5600)	3.3463**** (3.6300)	4.8547**** (3.3300)	4.6893**** (3.1500)
number of observations	93	92	92	86	92	86
R-squared	0.21	0.14	0.24	0.28	0.26	0.29

Notes: Values of standard errors in brackets. *, **, *** and **** mean coefficients are significant respectively at 90%, 95%, 99% and 99.9%.

4. Young poor countries, vibrant emerging ones and ageing mature countries.

The observation of world demographic and growth trends leads to distinguish at least three kinds of countries. There is a number of poor countries, with a very high, though generally decreasing, fertility rate, a high, though decreasing, mortality rate and a large rate of growth of population. The number of children and young people on total population is very high, but overall poverty and lack of industrialization and modern tertiary activities make it difficult to several young people to find a decent employment or even any employment. Although these countries often exhibit significant migration outflows and consistent remittances from abroad, their rate of development is rather slow. This partly depends on the fact that real investment tend to grow very slowly and provide an insufficient labor demand. Even educated people have difficulty in finding an adequate labor position, and this hampers the rise of human capital. Moreover the State has limited financial means and so generally devotes scarce funds to public education, while poor families with many children have difficulties in providing

adequate nourishment, health and education to all their children and in renouncing to their possible work contribution. Moreover, with imperfect capital markets, most poor and middle class families are usually unable to provide funds to start new enterprises or to realize important innovations eventually conceived by gifted members of their families.

At the opposite there are rich mature countries, such as most Western European countries and Japan, which have very low fertility rates and long life expectations. In the last two or three decades these countries have experienced very low growth rates of population. The natural rate of the local population is around zero and in most Western European countries the slow rate of growth of population is substantially due to consistent immigration inflows. Also these countries have difficulties to rapidly grow. The ageing of population leads to increased public and private expenditure on pensions, health and care services. As paragraph 3 has shown, the dependency rate for older people is in these countries very high. The dependency rate is, however, relatively low for children, but in industrialized countries this possible advantage is largely offset by the prolongation of the studies to higher education and by the fact that in several countries a consistent percentage of young people remains unemployed. Moreover a older population means three other negative implications. In democratic countries the high average age of population tends to lead to economic policies relatively favorable to people over 40 and less favorable to younger people, which represent a minority in the total number of voters. Moreover, high average age leads to less dynamism in innovating and in starting entrepreneurial activities. Finally old-age people tend to behave differently from younger people in their decisions to save, to consume and to invest. They tend to consume more services than goods and they usually prefer to employ their savings in housing and relatively safe financial assets rather than in risky productive investment.

Also most Eastern European countries have experienced very low or negative rates of growth of population and low average annual rates of economic growth. This is partly due to the great difficulties of the transition period and to large emigration flows to richer countries, but also, in several countries, to a low fertility rate and a rapid growing ageing of the population.

There is, finally, a third kind of countries mainly composed by emerging countries like China, India and Brazil and by some developing countries[13], which have been able to exploit the "demographic dividend": China is now approaching the risk of an excessive ageing of population, due to their strict "one child" demographic policy, while India and Brazil will be able to enjoy the advantage of the demographic dividend for the next two-three decades.

5. Conclusions.

The presence of a inverted-U curve seems to suggest demographic, immigration and development policies which would in the long-run gradually lead to a convergence towards rates of growth of the population capable of maintaining a sustainable increase of population and reduce both the problems associated to the polar cases of an excessive population growth and an excessive ageing of the population. However, institutions, cultural factors and social and economic problems can deeply differ among countries, so that there will probably remain a considerable variety of demographic and economic trends.

[13] Also the United States have been able to maintain, partly through a robust immigration inflow, a consistent rate of growth of population (around 1% per year) and so escape the negative effects of excessive ageing.

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STATISTICAL APPENDIX

Table A1. Average annual growth rate of population and per-capita GDP by country: 1980-2010

COUNTRIES	average annual growth rate of population	average annual growth rate of per-capita GDP
Bulgaria	-0.71	1.32
Estonia	-0.46	2.21
Latvia	-0.43	1.68
Ukraine	-0.32	-0.63
Hungary	-0.23	1.02
Czech Republic	-0.03	-0.77
Romania	-0.03	0.33
Russian Federation	0.01	-1.58
Croatia	0.08	1.08
Italy	0.10	1.25
Lithuania	0.11	1.49
Belgium	0.19	1.63
Denmark	0.25	1.50
Poland	0.26	2.11
Japan	0.27	1.70
Austria	0.28	1.83
Sweden	0.29	1.70
Slovenia	0.30	2.37
Portugal	0.31	1.94
Finland	0.32	1.99
Slovak Republic	0.32	2.36
United Kingdom	0.34	1.85
Greece	0.36	1.73
Albania	0.38	2.76
Norway	0.45	2.11
France	0.54	1.30
Netherlands	0.57	1.64
Switzerland	0.59	0.99
Uruguay	0.60	1.78
Spain	0.72	2.03
South Korea	0.82	5.69
Taiwan	0.85	5.05
New Zealand	0.98	1.34
Ireland	1.03	3.37
China	1.04	7.59
United States	1.04	1.70
Canada	1.06	1.45
Hong Kong	1.13	3.60
Thailand	1.19	4.29
Sri Lanka	1.20	3.65

Argentina	1.26	0.95
Australia	1.30	1.97
Chile	1.38	2.90
Indonesia	1.63	3.14
Zimbabwe	1.63	-1.55
Brazil	1.65	0.90
Tunisia	1.67	2.61
Mexico	1.67	0.65
Vietnam	1.72	4.93
Morocco	1.73	1.94
South Africa	1.74	0.48
Turkey	1.84	2.39
Peru	1.84	0.90
India	1.86	4.31
Bangladesh	1.91	2.85
Mozambique	2.02	2.48
Bolivia	2.03	0.59
Venezuela	2.06	-0.09
Ecuador	2.10	0.59
Iran	2.17	1.36
Angola	2.23	2.04
Singapore	2.25	3.82
Egypt	2.25	2.45
Philippines	2.27	0.78
Israel	2.28	1.85
Mali	2.31	1.33
Malaysia	2.36	3.43
Nigeria	2.40	1.40
Kuwait	2.40	-0.65
Pakistan	2.48	2.62
Cambodia	2.49	3.57
Cameroon	2.67	-0.04
Ghana	2.68	1.31
Iraq	2.73	-4.45
Tanzania	2.73	1.20
Senegal	2.84	0.56
Sudan	2.84	1.36
Zambia	2.96	-0.48
Ethiopia	3.00	1.43
Madagascar	3.03	-1.60
Côte d'Ivoire	3.03	-1.75
Kenya	3.04	0.27
Malawi	3.05	0.50
Oman	3.10	2.95
Syria	3.12	0.57
Burkina Faso	3.20	1.60
Yemen	3.20	1.09

Saudi Arabia	3.20	-0.90
Niger	3.24	-1.76
DR Congo	3.26	-3.07
Colombia	3.29	0.13
Uganda	3.35	2.33
Jordan	3.68	0.72
Average for 93 countries	1.55	1.50

Source: GGDC, Total Economy Database.

Table A2. Age dependency ratio by country

COUNTRIES	**total**	**old**	**young**
Albania	60.88	10.66	50.22
Angola	97.87	5.03	92.85
Argentina	61.87	15.46	46.41
Australia	50.19	17.62	32.57
Austria	48.71	22.80	25.90
Bangladesh	76.29	5.67	70.62
Belgium	50.97	23.76	27.20
Bolivia	79.40	7.27	72.13
Brazil	60.57	8.06	52.51
Bulgaria	48.14	21.53	26.61
Burkina Faso	96.89	4.72	92.17
Cambodia	81.83	5.29	76.54
Cameroon	90.23	6.77	83.45
Canada	46.21	17.16	29.05
Chile	55.02	10.56	44.46
China	50.46	9.25	41.22
Colombia	65.31	7.43	57.87
Croatia	47.57	20.09	27.49
Czech Republic	48.03	19.57	28.45
Cote d'Ivoire	86.25	5.61	80.64
Congo, Dem. Rep.	99.72	5.45	94.27
Denmark	50.33	22.83	27.50
Ecuador	72.05	8.22	63.83
Egypt, Arab Rep.	75.32	6.97	68.35
Estonia	50.01	20.60	29.41
Ethiopia	92.20	5.61	86.58
Finland	48.86	21.07	27.79
France	53.46	23.10	30.36
Ghana	84.86	5.84	79.03
Greece	49.37	22.85	26.52
Hong Kong	40.72	13.51	27.21
Hungary	48.78	21.09	27.69

India	67.71	6.82	60.90
Indonesia	61.58	7.07	54.51
Iran, Islamic Rep.	73.24	6.84	66.40
Iraq	90.86	6.60	84.26
Ireland	56.91	17.36	39.55
Israel	65.51	15.69	49.81
Italy	49.17	24.81	24.36
Japan	47.06	21.66	25.40
Jordan	85.51	5.90	79.61
Kenya	98.00	5.47	92.53
Kuwait	48.72	2.10	46.62
Latvia	49.01	20.79	28.21
Lithuania	50.05	18.96	31.09
Madagascar	92.10	6.12	85.98
Malawi	97.63	5.72	91.91
Malaysia	65.04	6.42	58.62
Mali	90.43	5.13	85.30
Mexico	70.95	8.16	62.78
Morocco	70.33	7.53	62.80
Mozambique	91.06	6.00	85.06
Netherlands	47.09	19.33	27.76
New Zealand	52.70	17.28	35.42
Niger	103.63	4.03	99.61
Nigeria	90.59	5.67	84.92
Norway	54.33	23.76	30.57
Oman	74.16	3.80	70.36
Pakistan	84.35	7.10	77.25
Peru	69.20	7.51	61.68
Philippines	74.32	5.97	68.35
Poland	49.10	16.68	32.42
Portugal	50.92	21.89	29.03
Romania	49.03	17.85	31.18
Russian Federation	45.89	16.79	29.09
Saudi Arabia	73.57	4.46	69.11
Senegal	93.94	4.80	89.14
Singapore	40.03	9.22	30.80
Slovak Republic	49.22	15.87	33.35
Slovenia	45.66	18.56	27.10
South Africa	66.59	5.80	60.79
Korea, Rep.	44.46	9.15	35.31
Spain	49.55	21.88	27.67
Sri Lanka	55.50	9.13	46.37
Sudan	85.48	5.87	79.62
Sweden	55.02	27.01	28.01
Switzerland	47.56	22.11	25.45
Syria	89.61	5.36	84.25
Taiwan			

Tanzania	93.26	5.41	87.85
Thailand	52.40	8.27	44.13
Tunisia	65.41	8.76	56.65
Turkey	63.29	7.77	55.52
Uganda	105.38	5.51	99.87
Ukraine	48.03	19.86	28.17
United Kingdom	53.20	24.09	29.10
United States	50.94	18.43	32.51
Uruguay	59.98	19.62	40.37
Venezuela, RB	66.67	6.91	59.76
Vietnam	71.14	8.91	62.23
Yemen, Rep.	106.24	4.64	101.60
Zambia	95.12	5.54	89.58
Zimbabwe	91.86	6.27	85.60

Source: World Bank, World Development Indicators.