World Population Growth and Fertility Patterns, 1960-2000. A Simple Model Explaining the Evolution of World's Fertility During the Second Half of the 20th Century

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ABSTRACT.

In this paper we attempt to describe the general reasons behind the world population explosion in the 20th century. The size of the population at the end of the century in question, deemed excessive by some, was a consequence of a dramatic improvement in life expectancies, attributable, in turn, to scientific innovation, the circulation of information and economic growth. Nevertheless, fertility is a variable that plays a crucial role in differences in demographic growth. We identify infant mortality, female education levels and racial identity as important exogenous variables affecting fertility. It is estimated that in poor countries one additional year' of primary schooling for women leads to 0.614 child less per couple on average (worldwide). While it may be possible to identify a global tendency towards convergence in demographic trends, particular attention should be paid to the case of Africa, not only due to its different demographic patterns, but also because much of the continent's population has yet to experience improvement in quality of life generally enjoyed across the rest of the planet.

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Key Words: demographic transition, female education, infant mortality, race, convergence.

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WOLRD POPULATION GROWTH AND FERTILITY PATTERNS, 1960-2010. A SIMPLE MODEL EXPLAINING THE EVOLUTION OF WORLD'S FERTILITY.

Introduction.

Today, most of the policymakers and people who deal with social, economic and demographic issues regard population growth as a problem. That notion, of course, dates back at least to Malthus and his predictions based on the dynamics of the population growth, vis-a-vis resource availability. In the early 21st century, prices of certain basic food products have begun to rise. It is widely felt that if there are too many people now, the situation will be even more difficult in the future. Although the prices of calories and energy have risen over the last decade, the world is not only increasingly populated but also increasingly industrialized and rich. The question of whether or not there are

too many people deserves more attention, since population growth can have pros and cons. In the 19th and 20th centuries population growth and increased population density were considered an asset for many nations as factors contributing to: economies of scale and cheaper labor, and the bases for urbanization and economic growth.

Despite all the concerns, the population, while still growing, has been doing so at diminishing rates since 1970. A key question is whether there are too many children, with population growth reflecting a high rate of fertility, or whether the population explosion in recent years has been due to improved health standards and reduction of mortality, stemming from material prosperity and technological progress.

In this paper we aim to provide preliminary data that may help paint a picture of the variables that influence demographic growth worldwide and their regional variance. The intention in this exploratory article is to set out some working hypothesis on the reasons behind demographic growth and its most plausible future evolution. In forthcoming papers, we hope to draw on preliminary results to model the worldwide population dynamics for the second half of the 20t century, based on economic, demographic, and cultural factors, including , in particular, female and child education and employment, infant mortality, and changing income levels, in addition to ethnic differentials. We shall first concentrate on the issue of whether the determining variable behind demographic growth is fertility (and therefore reproductive habits) or mortality (and therefore progress in the health arena). We will refrain from analyzing nuptiality here, since religion has ceased to be as important in terms of fertility dynamics in the period under

consideration, having lost much of the influence that, before 1960, it had held over family formation and the age at which couples conceived their first child.

Furthermore, finding a homogeneous indicator for family formation and nuptiality for historical populations would be very difficult. Most of the literature, including the majority of papers on historical demography, deal with Europe and the US, populations that were part of the "European demographic system", in which children were conceived by married, monogamous couples (indeed, most statistical calculations on nuptiality and fertility are based on this sort of family arrangement). That was certainly the case in Western Europe, where, as Voth and Voigtländer (2013) have demonstrated, delaying the age of marriage reduced fertility by a third. That created a situation of low demographic pressure on economic assets, leading to a marginal surplus of income and increase in consumption which economic vibrancy of preindustrial western Europe can be attributed. When extending the sample to all the world's civilizations and religions, however, it is necessary to make certain simplifications regarding the culture of, and motives for, marrying and having children. Polygamy is a feature of some African societies where the ability to conceive children basically depends on women's fertility rather than other social or cultural determinants, such as those applicable in most western societies. We seek to stress our awareness of this limitation, and of the fact that attempting to capture fertility patterns that are common to and statistically significant for all the world's people entails a loss of explanatory power. The questions we search to answer on the basis of the data and the results which follow this introduction are only relevant to fertility patterns in the second half of the 20th century. We think that the limitations of nuptiality involved in the 19th century European demographic system would be relevant if

fertility were increasing and the number of years in which women can conceive were a key factor in fertility levels. As will become apparent, our intention is not to explain which factors are obstacles to female fertility reaching its full potential, but rather to explain the main factors behind declining fertility. Social factors preventing the maximum reproductive level being attained are thus of secondary importance.(1)

1. *ARE DEMOGRAPHIC PATTERNS CONVERGING ACROSS THE WORLD?*

In the concluding volume of the seminal work on the demographic transition in Europe (Coale and Watkins, 1986), it is stated that despite there being sharp contrasts in the economic achievements of the continent's countries, the demographic transition took place at much the same time inside most of Western Europe. It appears that once a threshold level of per capita GDP was crossed in 19th century Europe, epidemics and famines ceased to threaten the population, and adult and infant mortality diminished. More recently, as Becker et al (2005) indicate life expectancy has converged across nations over the last half-century.

The timing of declines in mortality throughout the world has thus been more similar than would be predicted on the basis of economic factors. Meanwhile, urbanization and industrial growth brought about a reduction in legitimate fertility. As a result of the circulation of information due to internal migrations, the communications revolution and rising levels of literacy, the influence of towns and cities on the demographic behavior of extended regions and countries increased (Wrigley, 2004; De Vries, 1985, Voth and Voigtländer, 2013). That is why, despite economic divergence, population dynamics tended to converge. The scope that the

transport revolution and migration offered for exchanging information on improving health and reproductive practices was one of the factors that fostered territorial homogeneity and alignment of demographic variables, not only in 19th century England but also Europe in general. Certain authors have used micro historical methods to emphasize the distinctive features of several European regions, highlighting religious beliefs and socioeconomic variables that may help to explain why behavior in different regions is similar but not always identical (Brown and Guinnane, 2002). (2)

The European demographic transition is unique in that it took place relatively early. According to World Bank datasets and Annual Reports, most of the world still had high rates both of fertility and of infant mortality in 1960. Thus, in the post-WWII period, the countries benefiting from the Golden Age of Capitalism had not yet experienced the demographic transition. That is particularly true of poor countries, those affected by the tropical pattern of poverty. As late as 1995, those tropical countries were among the poorest in the world, a situation that has generated a long literature on the geographical reasons for economic growth or its absence. That, however, is not our main focus of interest here. The important consideration for our purposes is that in 1960, the poorest countries in the world (countries in the tropics) were those with the highest fertility and infant mortality rates, as well as the lowest rates of female and child education. It is plausible to think that the communications and information exchange network referred to earlier had still to develop in the countries in question to pave the way for declines in fertility and infant mortality, mirroring innovations already underway in the developed world.(3)

The global scenario had changed significantly by 2010, however. By then, a time marked by the communications revolution, most of the world had shifted to modern demographic patterns. Thus, on the eve of the 21st century, much of the planet had undergone transition from high to relatively low fertility (and high to low infant mortality rates) the main exception being the countries of Sub-Saharan Africa. This is a striking case, as Sub-Saharan Africa is not only a high fertility region but also the region with the highest levels of infant and adult mortality. Thus, in this belated global demographic transition there is still a group of countries lagging behind, marked by characteristics that seem to limit economic growth. In Africa, this has meant international as well as civil wars, but also hunger and disease (pandemics) leading to death. Those factors help explain the high levels of mortality, as well as the high levels of fertility observed, bearing in mind the considerable probability of death during the first year of life. .

Figures 1 and 2 and Tables 1, 2 and 3 show aspects of the world's demographic development by region. The tendency towards regional convergence of both fertility and infant mortality variables should be noted in the tables and figures. With some delay, the world's slowest-developing regions, demographically speaking, such as sub-Saharan Africa and South Asia, show a trend of convergence with the core countries of Europe and North America. To answer the question proposed above, that of why the world's population is growing, this growth is due not to an increase in fertility levels but to improved health conditions in a major group of countries. Adult and infant mortality rates have improved in all countries, with most of the world's population living longer and enjoying relatively higher living standards.

INSERT FIGURES 1 & 2 AND TABLES 1, 2 & 3 ROUND ABOUT HERE

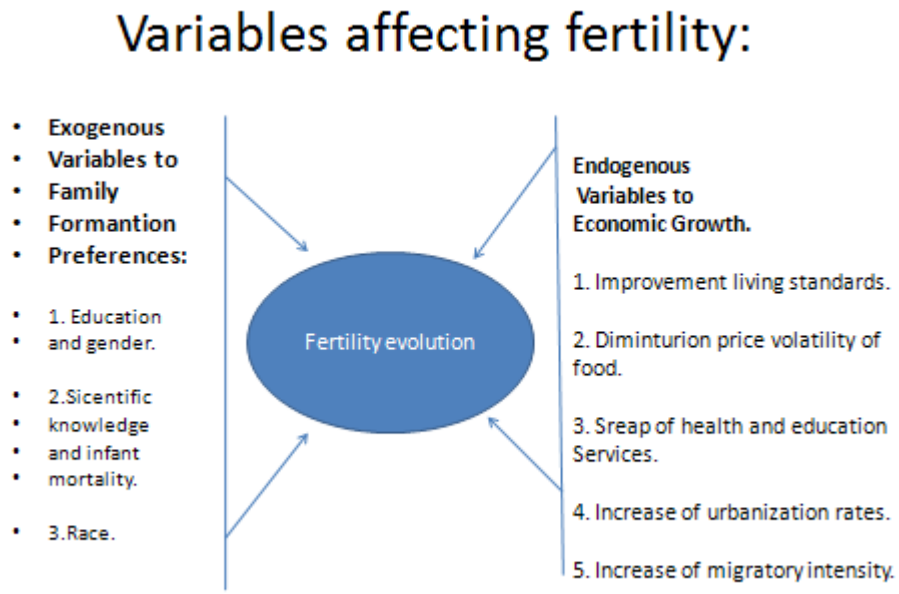
2. A simple model of the reasons for declining fertility.

The most relevant studies (and the data we present here) indicate a tendency towards convergence across nations in fertility and mortality in the period under consideration. We have also observed that the relationship between demographic variables and income levels is non-linear. As mentioned previously, life expectancies improved considerably in the 20th century, most notably up the 1960s, thanks to improvements in nutrition and health (Fogel, 2005). Generally speaking , life expectancies appear to have diminishing returns in relation to income, and Fogel predicts that they will not increase by more than 10-15 years during the 21st century (compared to having almost doubled in the 20th century). In section 2 we indicated that fertility has tended to converge at a historically low level, close to replacement level. Africa is still the continent with the highest fertility rates. High fertility in poor countries mainly in sub-Saharan Africa remains a matter of concern for the UN. Even if fertility rates are diminishing, present demographic patterns and Net Reproduction Rates point to the population of the group of countries in question doubling every 30 years. If all the world's countries, including those of sub-Saharan Africa, achieve fertility rates close to the replacement level, by 2050 the world population should peak at 9.1 billion, a level most economic authorities hope will not be exceed (Sachs, 2008, p. 167). In this period there will be a dramatic shift in the regional distribution of the global population. Since below-replacement fertility in the developed nations has already

begun, and it should take several decades for this to occur in the less developed world, the share of the developed nations in world population will decline. (4)

The common view of demographic planners is that we should try to achieve fertility levels close to or below the replacement level, not to have population increase. In this section we model the factors that influence fertility and in the next we present a regression analysis based on the variables included in the model discussed here.

FIGURE 3



In Figure 3 we divide the variables that affect fertility into endogenous and exogenous variables. The endogenous variables are those related to economic growth, which constitute the main set of variables considered by most of the models that deal with the European demographic transition referred to in section 2. Also in section 2, we made the point that in most studies of fertility of the

continent, fertility rate reductions are generally linked to endogenous factors associated with economic growth, such as: improved living standards, urbanization and internal migrations, an improved supply of health, increased education, improved agricultural technologies, and changes in food prices. The first variable we consider is the impact on fertility of changes in the level of per capita GDP.

Clearly, exogenous variables not directly related to economic growth can also explain fertility in poor countries in the decades under consideration. They include: infant mortality, female education, and factors related to racial diversity. According to Williamson (1998) infant mortality has played a major role in explaining fertility changes in countries in East and South Asia in recent decades. He regards this variable as exogenous since it mainly depends on scientific knowledge (vaccines, antibiotics, penicillin, etc) developed through medical innovation in the West in the 20th century, as well as successful public health interventions. Due to a substantial increase in the number of children surviving their first year of life, the reduction in infant mortality led to a fall in total number of births per family, due to longer child-spacing as a result of prolonged lactation. Also parents reduced the number of children to ensure the continued survival of their existing offspring, as well as the ability, when desired, to achieve a certain number of live children with fewer births.(5)

Another exogenous factor influencing families' preferences in terms of having more or less children consists of education levels for the mothers. According to data provided by Barro and Lee (2013) on the female/male education ratio (calculated on the basis of the number of years people spend in the education

system by regions), the amount of education women receive is influenced by culture, and the regions with lowest fertility (and education) levels are in East and South Asia (see Boserup, 1970; Barro and Lee 2000; Sen, 1990, 1992, 2003). However, in societies where families do invest in human capital, the result can be an increase in the value of women's paid work (wages), affecting the opportunity costs involved in unpaid domestic work, including the bearing and raising of children. Women's preferences consequently change and they begin to allocate more time to paid work and less to reproductive work and other unpaid activities, ultimately causing a fall in fertility and a rise in female labor force participation (Galor and Weil, 1996; Dreze and Sen, 1995; Caldwell, 1982). Of interest, women with a higher level of education not only produce less children but also "higher quality" children (Becker, 1991). The effects that the education of the mothers has on children's health and education in poor countries have been well outlined in the literature (Le Vine et al, 1991, Baizan and Camps, 2007).(6)

A third exogenous factor is race and ethnicity. The disparity between the demographic patterns of different races is narrowing. This pattern is seen also by the convergence of mortality rates among blacks and whites in the US in the second half of the 20th century (see table3), due in part to the democratization of the supply of public goods, such as water sanitation and other health services (see Troesken, 2004), as well as to a degree of convergence in income levels. (7)

We present two models in the following section. The purpose of the first is to identify relevant variables, for explaining the global evolution of fertility. Since there is a considerable disparity in the magnitude of the numerical value of certain variables the model is presented multiplying the values for fertility and infant

mortality per thousand. Our second model presents variables affecting the gender gap.

3. THE EMPIRICAL RESULTS ON VARIABLES AFFECTING FERTILITY.

Table 4 contains the results of regression 1, which is based on panel data for 145 countries (Barro-Lee 2013 and the World Bank) for which we have continuous information corresponding to every five years period from 1965 to 2010. The total number of observations is 1,012 as there is a considerable amount of missing values. We avoid country fixed effects here, since some variables, such as race and ethnic fractionalization are held constant. The variables we include in this panel regression are per capita GDP, population size, infant mortality, the interaction of infant mortality with Indian race, the interaction of infant mortality with black population, female education, ethnic fractionalization and the effects of ethnic composition (share of Indian and blacks in the total population).

INSERT TABLE 4 ROUND ABOUT HERE.

One of the table's most significant results are the very low explanatory power of income levels (per capita GDP) and the high impact of infant mortality, race, and female education. Taking into account that the dependent variable is fertility rates*1000 the impact of income is almost nil. Based on this finding we can infer that endogenous variables, associated with economic growth (such as those shown

in the diagram presented earlier, including: living standards, urbanization, internal migrations, and services supply) are unimportant in explaining the evolution of fertility in the second half of the 20th century. That may be because minimum necessary supplies of health services and other public goods characteristic of the modern world in the 20th century (such as water sanitation, well established transport and communication networks, basic agrarian technologies for avoiding food output and price volatility) were already in place in most (although obviously not all) countries by the time period in question. It also may be due to the world having become increasingly globalized in terms of communications and transport, meaning that the human capital factors so important to the spread of the demographic changes in Europe were already being established across the planet in the second half of the 20th century.

If income is not relevant, which variables are really significant? According to our model the relevant variables are those presented previously as exogenous to family formation preferences, i.e. infant mortality, female education, and race (particularly the difference between Indian, blacks and whites). An increase of one point in infant mortality rates leads to an increase of 0.012 points in fertility rates. A one year increase in women's primary schooling causes the number of children born to fall by 0.614 (worldwide average). Fertility levels are higher among blacks and Indians relative to whites. Nonetheless, combining the variables being black or Indian with infant mortality has a negative effect on fertility levels. That may be due to extraordinary mortality caused by pandemics and civil wars in the parts of the world inhabited by blacks and Indians. Mortality due to epidemics and wars can produce an imbalance in a country's sex ratio or make it impossible for many women to have children because of the spread of diseases such as AIDS.

Based on these results, we can conclude that the way to reduce fertility levels in sub-Saharan Africa and poor countries elsewhere is to improve infant mortality rates by means of scientific and medical innovations that pave the way for the eradication of pandemics such as AIDS, HIV, and malaria. The diseases in question kill people of all ages and are a factor in people failing to act in a manner in keeping with expectations of being better off in the future. Additionally, high levels of infant mortality mean that only a limited number of the babies born actually survive the first year, leading many women to have many children to ensure that at least some of them will reach adulthood, in the hope that they will be able to support the family when their parents grow old.

Our findings also highlight the high impact of female education on fertility levels. Indeed this is the most powerful variable to explain fertility diminution in poor countries. As we already said, one year more of female primary education in poor countries leads to a diminution of 0,614 births per couple. Therefore, gender differences in the access to education and wealth may be very important to explain fertility evolution. Table 5 contains results related to variables affecting the gender gap worldwide and therefore factors affecting the access to education by women. In the case of this second model, we only have results for the variables involved for the year 2003, and the regression is therefore based on cross-section data across countries. Nonetheless, the results are significant, with very important implications for those seeking to control levels of fertility, as countries such as China and India have attempted in the recent past. The tables and figures presented in section 2 show that fertility levels in South and East Asia fell sharply between 1960 and 2010, mainly due to family planning policies being exogenously imposed on couples. As both societies are highly biased where gender is

concerned, programs like China's one-child policy have resulted in an increase in infant mortality rates of girls relative to that of boys, in sharp contrast to what is happening in the rest of the world. That is not to suggest that infanticide is practiced in these countries. However, if a couple wants a son but official policy restricts them to having just one child and they have a daughter the main consequence is that they seek to give her in adoption or, as in the case of Taiwan, to arrange a child marriage for her. The end result is an increase in infant mortality levels among girls relative to among boys, as several research projects demonstrate.

4. CONCLUSION

There have been some common movements in a number of demographic variables in most parts of the world in recent years, although substantial differences in the absolute levels of those variables still remain. What is perhaps most interesting, is the similar timing of such movements in fertility and mortality rates, as well as in the various related explanatory factors such as infant mortality rates, years of schooling of women, female labor force participation, and the relevant economic factors. Such similarity in the timing of changes raises questions about the importance of country specific factors as opposed to those influenced by broader international forces. This, of course is not a new point. We have already mentioned the similarity in national fertility levels in the European Fertility Transition in the late 19th century and, the similarity of movements in mortality

rates among the black and white populations of the U.S. in the 20th century. Whether such similarity is due to technological aspects, external effects in the communication of ideas, the spread of changes in tastes, or the direct intervention of international agencies or foreign countries, is open to debate, as is the importance to be attributed to globalization and international connections. Civil wars and international warfare, phenomena with a rather long and continuous history, have been another cause of changing fertility and mortality patterns. It is estimated that war has been responsible for over 15 million deaths in Africa in the past half century, contributing, in conjunction with diseases, a pattern of basically unchanged fertility in sub-Saharan Africa up to 1990, with only a moderate decline in the subsequent decade. The regions of sub-Saharan Africa and South Asia have the highest fertility rates, despite falls in recent years, as well as the lowest female literacy rates, and rather different female labor force participation rates. The relationship between fertility rates and the degree of inequality requires further study, but it is probable that greater inequality and higher rates of fertility are linked.

Worldwide trends in the second half of the 20th century included an increase in the number of years of schooling received by women and in the female labor force participation rate, something that many predicted to lead to a decline in fertility because of the increased value of a woman's time and the effect this has on the cost of childbearing. That is clearly the pattern predicted for developed economies, where female labor force increases reflect an improvement in the opportunities available to women and allow for reductions in child labor to permit increased education. However, this relationship has been U-shaped (Goldin, 1994), since female labor force participation is also very high when income levels are low

and female and child labor is necessary to support families. In sub-Saharan Africa, where rates of female labor force activity are high and rates of female education and literacy are low, fertility rates are high, which can be interpreted as a consequence of another important variable that, according to our analysis, plays an important role in shaping fertility, namely, high rates of infant mortality. Furthermore, sub-Saharan Africa, unlike other regions, is unique in that its levels both of female labor force participation and child labor activity are high. This takes us back to the long standing issue of policy towards developing nations. How can we determine what actions to take, who should become the major agents of change, and what is the feasible time period within which to accomplish those goals?. (8)

Table 1a. Mean fertility by region, 1960 (births/women at reproductive age)

Fertility 1960	**Mean**	**Std. Dev.**	**Min**	**Max**
OECD	2.99	0.93	2.17	6.28
Sub Saharan Africa	6.41	0.82	4.06	8
Latin America	6.17	1.22	2.87	7.35
Central Asia & Middle East	6.82	1.22	3.87	7.75
South Asia	6.31	0.75	5.27	6.98
East Asia-Pacific	5.18	1.52	2.04	6.97
non-OECD Europe	2.82	0.59	2.02	3.44
North Africa	7.16	0.13	7.03	7.34

Table 1b: Mean fertility by region, 2010

Fertility, 2010	**Mean**	**Std. Dev.**	**Min**	**Max**
OECD	1.74	0.38	1.23	3.03
Sub Saharan Africa	4.62	1.22	1.47	7.06
Latin America	2.63	0.58	1.47	3.98
Central Asia & Middle East	3.98	0.80	1.67	4.70
South Asia	2.97	1.42	1.75	6.29

East Asia-Pacific	2.76	1.17	1.13	5.58
non-OECD Europe	1.43	0.13	1.15	1.56
North Africa	2.98	1.03	2.13	5.2

Source: World Bank datasets

Table 2a. Mean infant mortality rates by region, 1960 (deaths of children younger than one /births)

IMR, 1960	**Mean**	**Std. Dev.**	**Min**	**Max**
OECD	0.04	0.04	0.003	0.18
Sub Saharan Africa	0.17	0.03	0.068	0.219
Latin America	0.10	0.04	0.05	0.19
Central Asia & Middle East	0.14	0.05	0.031	0.212
South Asia	0.15	0.05	0.069	0.186
East Asia-Pacific	0.07	0.05	0.02	0.163
non-OECD Europe	0.06	0.02	0.03	0.088
North Africa	0.17	0.01	0.158	0.178

Table 2a. Mean infant mortality rates by region, 2010

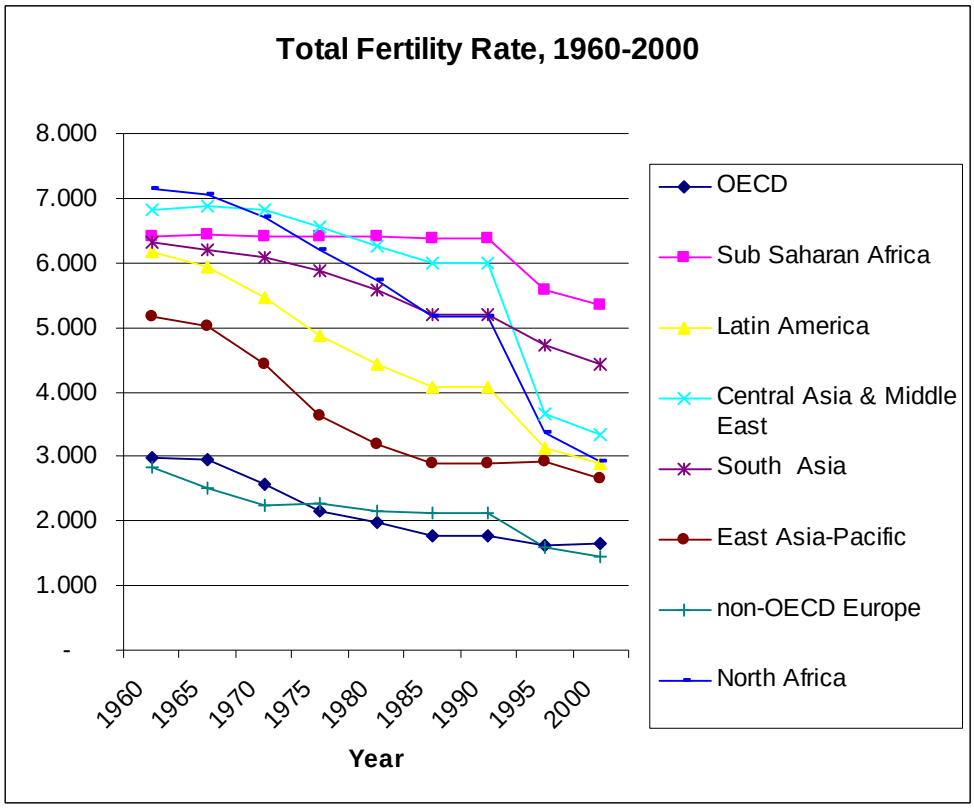
IMR, 2010	**Mean**	**Std. Dev.**	**Min**	**Max**
OECD	0.004	0.003	0.003	0.003
Sub Saharan Africa	0.07	0.03	0.01	0.12
Latin America	0.02	0.01	0.005	0.07

Central Asia & Middle East	0.02	0.016	0.006	0.05
South Asia	0.04	0.02	0.01	0.074
East Asia-Pacific	0.02	0.01	0.002	0.05
non-OECD Europe	0.01	0.004	0.003	0.019
North Africa	0.03	0.022	0.013	0.07

Source, World Bank datasets.

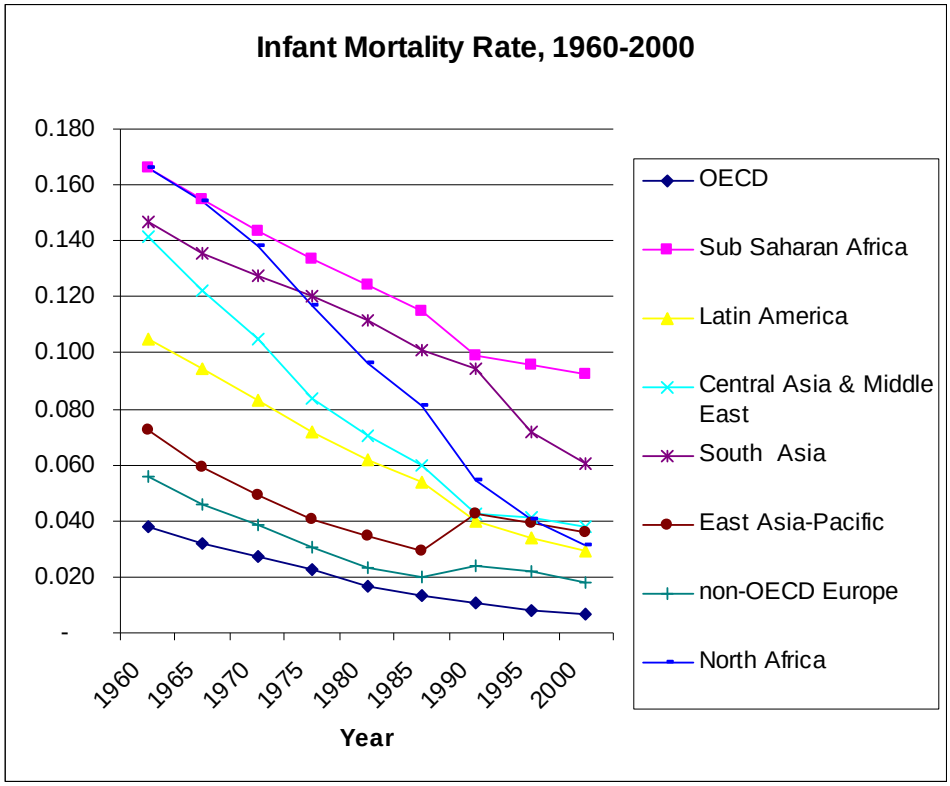
FIGURE 1

Figure 1. Trends in total fertility rates by region, 1960-2000



Source: World Bank Datasets.

FIGURE 2.



Source: World Bank Datasets.

TABLE 3: MORTALITY AND RACE; 20TH CENTURY US

Evolution of life expectancies at birth (male)

	White	Black	Difference (absolute) (years)
1900	48	33	15
1 920	56	47	9
1940	63	52	11
1960	68	60	8
1990	73	64	9
1998	74	67	7

Evolution of infant mortality rates:

(deaths during the first year of life/births)* 1000

	White	Black	Difference
1915	98.6	181.2	82.6
1930	60.1	99.5	39.4

1940	43.2	72.9	29.7
1960	22.9	44.3	21.4
1980	10.9	22.2	11.3
1998	6.0	14.3	8.3

Source: Carter, et al, Historical Statistics of the United States, Volume 1.

TABLE 4.

THE VARIABLES AFFECTING FERTILITY AT THE WORLD LEVEL, 1965-2010.

Panel Regression Analysis with year fixed effects.

Dependent variable: Fertility rates*1000.

Per capita GDP	-0.0000191
	(0.0000141)
Population	-0.000000935
	(0.000000226)**
Infant Mort*1000	0.0115972
	(0.0038167)***
Infant M*Indian *1000	-0.1840857
	(0.16889)
Infant M*Black *1000	-0.0664981

	(0.041899)*
Female education	-614.0746
(in years of primary school)	(20.93335)***
Ethnic fractionalization	781.9244
	(158.8337)***
Indian	15.38975
	(2.304191)***
Black	10.2047
	(1.104309)***
1965	-115.0131
	(198.729)
1970	-374.564
	(190.5099)*
1975	-666.8173
	(188.6754)**
1980	-825.4787
	(187.6272)***
1985	-949.4833
	(187.9235)***
1990	-771.5252
	(188.9998)***

1995	-1,439.589
	(180.2016)***
2000	-1,511.638
	(180.3185)***
2005	-1,392.792
	(184.8643)***
2010	-1,374.794
	(183.4817)***
Constant	6,222.175
	(182.8758)***

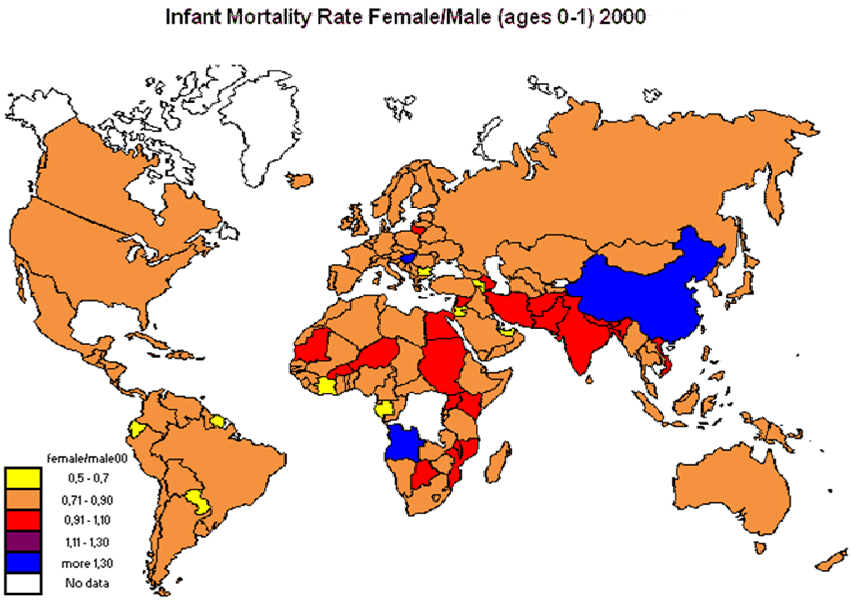
Number of observations= 1,012

F(19,992)=185.73

R-squared=0.7535

Data source: data on female human capital are from Barro and Lee (2013). Data on per capita GDP, Fertility and Infant Mortality come from the World Bank. Data on ethnicity are from Alberto Alesina's dataset. The aggregation from ethnicity to racial groups (black, Indian…) has been done aggregating Alesina's data.

FIGURE 4



Data source: World Bank Dataset.

TABLE 5

- EXPLAINING THE GENDER GAP, 2003.
- Dependent variable=log(ppp female earnings/ppp male earnings)

	(1)	(2)	(3)	(4)
Log per capita GDP	0.0009	-0.0228	-0.00977	-0.1752
	(0.0209)	(0.0208)	(0.0138)	(0.0155)
Log female ec.act.	1.0534	0.9619	1.0881	0.9739
	(0.0958)***	(0.1002)***	(0.0897)***	(0.0986)***
Latin America	-0.1416	-0.1685	-0.07564	-0.1658
	(0.0520)***	(0.0579)***	(*0.0542*)	(0.0529)***
East South Asia	0.0807	0.0642	0.0917	0.1107
	(0.0377)**	(0.4545)	(0.0369)***	(0.0351)***
Log education ga	-0.02971			
(years spent sch)	(0.0317)			

• Market openness		0.0407		
•		(0.3242)		
• %Indian			-0.0463	
•			(0.0023)***	
• Log Wom in Govern				0.0614
•				(0.03510)*
• Constant	-4.5697	-4.1010	-4.5976	-4.2743
•	(0.4230)***	(0.4311)***	(0.3504)***	(0.3765)***
• N	122	77	118	119
• R-squared	0.592	0.569	0.650	0.599

• Source: UN Human Development Report, 2005.

END NOTES

(1) Joachim Voth and Nico Voigtländer, "How the West 'Invented' Fertility Restriction," American Economic Review, 2013

(2) Ansley J. Coale and Susan C. Watkins (ed.), The Decline of Fertility in Europe (Princeton, 1986). Gary S. Becker, "Quantity and Quality of Life and World Inequality", The American Economic Review, 95:1 (2005). Edward A. Wrigley, Poverty, Progress and Population (Cambridge, 2004). Jan De Vries, European Urbanization (London, 1985). Joachim Voth and Nico Voigtländer, "How the West". John Brown and Timothy Guinnane, "Fertility Transition in a Rural Catholic Population: Bavaria 1880-1910," Population Studies 56 (2002), 35-49

(3) Jeffrey D. Sachs, Common Wealth. Economics for a Crowded Planet (New York, 2008). Jeffrey D. Sachs, The End of Poverty. Economic Possibilities for Our Time (New York, 2005). World Bank, World Bank annual reports, Washington D.C., various dates

(4) Sachs, Common Wealth. United Nations, Human Development Reports, various dates. Robert W. Fogel, The Escape from Hunger and Premature Death, 1700-2100. Europe, America and the Third World, (Cambridge, 2004).

(5) Jeffrey G. Williamson, "Demographic Change , Economic Growth and Inequality" in Nancy Birsdall, Allen C. Kelley and Steven W. Sinding (eds.), Population Matters (Oxford, 2001), 106-135.

(6) Robert J. Barro and John W. Lee, "International Measures of Schooling. Years and Schooling Quality," American Economic Review. Papers and Proceedings, 86 (2003), 218-23. Robert J. Barro and John W. Lee, "International Data on Education Attainment. Updates and Implications " Harvard University Working Paper Series, (2000). Ester Boserup, Women's Role in Economic Development, (Hants, 1970). Amartya Sen, "More than 100 Million Women are Missing", The New York Review, (1990). Amartya Sen, "Missing Women. Social Inequality Outweighs Women's Survival Advantage in Asia and North Africa," British Medical Journal, 304 (1992). Amartya Sen, "Missing Women Revisited. Reduction in female mortality has been counterbalanced by sex selective abortions," British Medical Journal (2003). Oded Galor and David N. Weil, "The Gender Gap, Fertility and Growth," The American Economic Review, 86, (1996), 374-387. Jan Dreze and Amartya Sen, India: Development and Participation, (Cambridge, 2002). John C. Caldwell, Theory of Fertility Decline, (New York, 1982). Gary S. Becker, Kevin Murphy and Robert F. Tamura, "Human Capital, Fertility, and Economic Growth, Journal of Public Economics, (1990). R.A. Le Vine and S.E. Le Vine et alt. "Women Schooling and Child Care in the Demographic Transition: A Mexican Case Study", Population and Development Review, 75, (1985), 992-1015. Pau Baizan and

Enriqueta Camps, “The impact of women’s educational and economic resources on fertility. Spanish birth cohorts, 1901-1950” in Angelique Janssens (ed.) Gendering the Fertility Decline in the Western World, (New York, 2007).

(7) Werner Troesken, Water, Race and Disease, (Cambridge, 2004).

(8) Claudia Goldin, Understanding the Gender Gap, (Oxford, 1990). Claudia Goldin, “The U Shaped female labor force function in economic development and economic history”, NBER Working Paper Series, 4704, (1994).