Does the Intelligence of Populations Determine the Wealth of Nations?

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Abstract. Can the average intelligence quotient of populations be considered the root cause of international development inequalities? Psychologists and some economic studies have proposed the existence of a link between intelligence quotient (IQ) and economic development. The paper tests this hypothesis, using different measures of economic development for the year 1500. Consistent with Jared Diamond's (1997) hypothesis, the paper shows how the differences in the timing of agriculture transition and the histories of States, not population IQ differences, predict international development differences before the colonial era. The average IQ of populations appears to be endogenous, related to the diverse stages of nations' modernization, rather than being an exogenous cause of economic development.

JEL Codes: 010, Z13.

Keywords: Intelligence quotient; economic development; evolutionary psychology; racial theories of intelligence; Flynn effect; economic inequality.

Inexorable doctrines on the inequality of human beings, adorned with a scientific veneer, are multiplied to infinity.

Jean Finot, *Race Prejudice*, 1907, p. 2.

1. Introduction

The economic and social conditions of nations are dramatically unequal. In 2010, the GDP per capita (PPP) of the USA, one of the richest countries in the world, was about two hundred times greater than that of the poorest one, the Democratic Republic of the Congo. Infant mortality, literacy rates, life expectancy and a myriad of socio-economic indicators reveal that standards of living are incomparably different between rich and poor countries.

Why do such differences exist? Economists have indicated geographic, historical, institutional, and also cultural and genetic differences as fundamental causes of the diverse long run development patterns of nations[1]. In the field of psychology, however, a radically alternative hypothesis has been proposed. According to this hypothesis, the international social and economic disparities would be, to a large extent, explained by differences in intelligence quotients (IQs) between populations and races[2].

The IQ-development hypothesis is far more widespread than a non-specialist reader might think. Illustrated in detail in two books by Richard Lynn and Tatu Vanhanen, *IQ & the Wealth of Nations* (2002) and *IQ & Global Inequality* (2006), this hypothesis constitutes, with variations, the object of a number of studies by psychologists and economists. According to these studies, the average IQ of populations explains the international differences in numerous social, institutional and economic outcomes: GDP per capita growth rates, education

[1] The literature on the fundamental causes of long-run growth is ample. For the role of institutions see, among others, Acemoglu, Johnson and Robinson (2001), for geography Gallup Sachs and Mellinger (1999), and for the genetic differences among populations Ashraf and Galor (2011a).

[2] It can be observed how the term "race", although widely used in social sciences, is in itself ambiguous when applied to humans (Sternberg, Grigorenko and Kidd, 2005; Hunt and Megyesi, 2008), since it has no genetic foundation (Barbujani 2005).

levels, health conditions, life expectancy, and also the incidence of corruption, the degree of democracy and the scientific and technological advancement of nations[3].

Since, in the IQ-development hypothesis, differences in intelligence are, at least partly, determined by genes, the diverse social and economic conditions of populations are deeply rooted in human nature.

The IQ-development hypothesis has notable implications for development and social policies. Analogously to the suggestions in Herrnstein and Murray's (1994) book, *The Bell Curve*, that indicated the gap in Blacks-Whites IQ scores as caused by genetic differences, thus suggesting the impossibility of improving the conditions of Blacks through appropriate policies, the IQ-development hypothesis has a logical policy-discouraging implication: since the economic fate of a people is partly determined by genes, there is no possibility of improving the lives of the poor. As clearly stated by Lynn and Vanhanen (2006, p. 293): "The persistence of differences in intelligence between nations is inevitable, and so too will be the consequence: the persistence of national differences in wealth. Or, as St. John put it two thousand years ago: '*The poor you have always with you*'".

Is intelligence really the root cause of economic development or does a more complex nexus between development and IQ exist? The Flynn effect, that is the massive IQ gains over time registered in 30 nations, suggests that social environment may exert a strong effect on average cognitive abilities as measured by IQ tests (Flynn 1987, 2009). Several explanations of the Flynn effect have been proposed: improvement in nutrition, health conditions, education, and the diffusion of technology and scientific reasoning. Summarising the evidence on the determinants of the Flynn effect, Nisbett *et al*. (2012: 12) claimed: "it seems likely that the ultimate cause of IQ gains is the Industrial Revolution, which produced a need for increased intellectual skills that modern societies somehow rose to meet". If environment is such a powerful force in determining IQ increases over short periods like a decade, we cannot exclude that current international IQ differences reflect, to some extent, nations' different paths of development. If so, the IQ of the

[3] A comprehensive review of the national IQs correlates is offered by Lynn and Vanhanen (2012). For a criticism of the Lynn and Vanhanen methodological approach see, for example, Moreale and Levendis (2013).

population should not be considered an exogenous cause of economic development, but rather as endogenous to the same process.

This paper's objective is to test the IQ-development nexus. The main hypothesis is very simple. If, as postulated by theory of racial differences in intelligence, differences in the IQs of populations are the fundamental cause of international inequality in economic development, and if, in the ultimate analysis, IQs differences lie in genetic differences among races/populations, then the strong link currently found between IQ and development should also be measurable, to some extent, for the past. This hypothesis is tested by using several proxies of economic and technological development, available for a large sample of countries, for the year 1500 circa.

The link between IQ and development is analysed on the basis of Jared Diamond's hypothesis – and subsequent findings by Hibbs and Olsson (2004, 2005), and Chanda and Putterman (2007) — according to which some geographic and biogeographic conditions in the Early Holocene period (12,000 + years ago), that determined differences in the timing of the transition to agriculture and animal husbandry in the different regions of the world, had long-lasting effects on economic development. These conditions were more favourable in Eurasia, where agriculture began early. An early start in agricultural transition conferred an initial advantage to societies, in terms of social, political and economic organization. Since, in the course of history, social, cultural and technological developments are cumulative, the different timings of agricultural transition, and accompanying social changes, have been important determinants of later technological and economic development. From this viewpoint, not genetic differences among populations or races, but a different process, led to modern international inequality.

The remainder of the paper is as follows: section II summarises the IQ-development hypothesis; section III tests this hypothesis; section IV offers a discussion of the results.

2. Intelligence and economic development

2.1. The IQ-development hypothesis

That of intelligence is an elusive concept, with different possible definitions (Cianciolo and Sternberg, 2004; Flynn, 2009). In psychology, cognitive abilities are considered to have many correlated dimensions. Since Charles Spearman's seminal study (1904), this correlation has been interpreted as reflecting an underlying "general factor of intelligence" or *g factor*. Statistically, the *g* factor is a latent variable that can be indirectly measured by the full-scale scores obtained on the standardized tests of cognitive ability or IQ (Dickens 2008).

Lynn and Vanhanen (2002, 2006), presented data on IQ test scores for 113 nations, and estimated data for another 79 on the basis of the IQs of neighbouring countries. In almost all cases, IQ data derives from tests on cognitive ability constructed in the USA or Britain and administered in other countries. Mean national IQs were calculated in relation to the mean IQ of Britain, set at 100 with a standard deviation of 15. National IQ data have been updated by Lynn and Meisenberg (2010) and by Lynn (2012).

Lynn and Vanhanen (2006) showed how national IQs are significantly correlated to several socio-economic outcomes: income per capita ($r = 0.60$ for the sample of 192 nations), adult literacy rates (0.65), life expectancy (0.75), and institutional variables, such as the level of democracy (0.53). Several studies, all using the same IQ data, have indicated how IQs are strongly linked to practically all indicators of the socio-economic and institutional conditions of nations. Mean national IQs are correlated to infant mortality, educational levels, the prevalence of HIV, income distribution as measured by the Gini index, (Kanazawa, 2006; Rushton and Templer, 2009; Rindermann, 2008) and with economic freedom and corruption (Meisenberg, 2012; Potrafke, 2012). Some economic studies indicate, furthermore, how the average IQ is a strong and robust explicative variable of GDP growth rates (Weede and Kämpf, 2002; Ram, 2007; Jones and Schneider, 2006; Jones, 2011) and also of total factor productivity growth (Jones, 2012).

It is easy to note that the existence of such correlations does not prove any causal link between IQ and development levels. In the literature, the IQ-development nexus is thus established on the basis of two main arguments: the first regards the large amount of evidence that, at an *individual level*, indicates a strong relationship between IQ and earnings; the second argument is extrapolated from correlations between national IQs and GDP per capita growth rates and levels.

At the *individual level*, the causal nexus between IQ and socio-economic status is quite simple to demonstrate: IQ scores measured in *childhood* correlate with several variables regarding the socio-economic conditions of individuals in *adulthood*. Intelligence quotient test scores correlate with income, employment status, life expectancy, health conditions and other socio-economic outcomes (Gottfredson and Deary, 2004; Irwing and Lynn, 2006; Zagorsky, 2007; Firkowska-Mankiewicz, 2011). Intelligence is, therefore, generally considered to be a powerful determinant of the economic success of individuals. The first argument consists, resultantly, in extending the evidence regarding individuals to *groups* and *populations*: if the smartest individuals have a greater chance of becoming rich then, analogously, the smartest populations, and also nations should, on average, be comparatively wealthier.

The second argument consists in relating current national IQs to historical data on GDP per capita levels and growth rates. Lynn and Vanhanen (2006) showed that IQs are correlated both with the growth rates of GDP per capita during the period 1500-2000 (r = 0.70), and with the income levels of 1500 (0.75). The data on GDP per capita used by the authors were taken from Maddison (2003). Since Maddison's estimates for 1500 cover only a very small sample of countries (21), the authors used regional GDP per capita to supplement missing observations; in this way, they obtained a sample of 109 nations for 1500 and 163 for the year 1820.

One main point in the previous scheme consists of the explanation of differences in national IQs. Since IQ variations in crystallized and fluid intelligence *between individuals* are in part (40% and 51% respectively) explained by genes (Davies *et al*., 2011), Lynn and Vanhanen (2006) assume that international

differences in IQ between *populations* are partially genetic and, consistent with the theories on racial differences in intelligence by Rushton and Jensen (2005), that these differences reflect the *racial* composition of nations. In fact, they categorize nations on the basis of races, showing that the East Asian populations have the highest median IQs, while the Africans the lowest, with differences among racial homogeneous countries (Tab. 1).

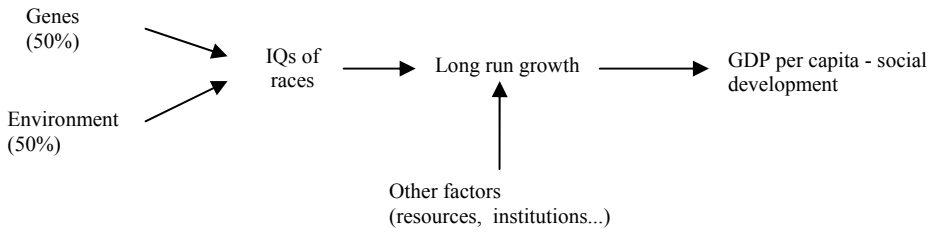
Tab. 1. "Race" differences in IQ

Race	Average IQs
East Asians	106
Europeans	99
Southeast Asians	90
Pacific Islanders	85
South Asians	84
Africans	67

Source: Lynn and Vanhanen (2006, p. 243)

What are the origins of these racial differences? The "cold-winter" theory, proposed by Lynn (1991), Rushton (1995) and Templer and Arikawa (2006), maintains that racial differences in general intelligence emerged during the course of human evolution. This theory claims that our ancestors, who left their ancestral environment in Africa around 70-60,000 years ago, migrating to Eurasia, encountered different climates and environments which posed new problems of adaption — mainly obtaining food, or keeping warm in colder temperatures — that then selected for greater intellective capacities. In a slightly different version, Kanazawa (2008) suggested that general intelligence evolved in response to novel evolutionarily problems, including, but not limited to, those of obtaining food and keeping warm in the northern latitudes of Eurasia. This would explain "the broad association between latitude or, more precisely, the coldness of winter temperatures and the intelligence of the races" (Lynn, 2006: 136).

Fig. 1. The relationships between genes, IQ and development



In short, the causal nexus between IQ and development can be schematized as illustrated by Fig. 1. Genes and the environment are assumed to equally determine general intelligence which, coupled with other factors, influence long run economic growth and the extent of global inequality among nations. On the basis of the evidence presented, Lynn and Vanhanen (2006, p. 24) claim that "the quality of human conditions tends to be the higher, the higher the average level of mental abilities (intelligence) of a nation."

3. Geography, biogeography and the intelligence of nations

3.1. Geography, biogeography and development in 1500

What can explain the strong relationship between economic development levels and national IQs? Why do more advanced nations have, on average, higher IQ scores? Does a primary nexus between general intelligence and long run economic development really exist or, more simply, do populations' IQs reflect the levels of development without being a primary cause?

To examine the relationship between economic development and IQs I have used the scheme proposed by Hibbs and Olsson (2004, 2055), subsequently extended by Chanda and Putterman (2007), to explain what influence the geographic and bio-geographic factors had on the formation of ancient agricultural societies, and later on (their) long run economic development. For simplicity, after Chanda and Putterman, this argumentation can be defined as the "early starts" hypothesis.

The early starts hypothesis can be summarized as follows: why did the birth of agriculture, which in some regions, such as the Middle East, Anatolia and Egypt, can be traced far back to the Neolithic era, between 9,000-8,000 B.C. – not extend to all regions? Why did some societies, such as the Maya and Aztec, know large scale agriculture only many centuries later, and why have other societies, such as

the natives of North-America, or the indigenous tribes of the Amazon, Papua New Guinea or Equatorial Africa[4], remained hunter-foragers to these days? What have been the consequences for the economic development of these different types of societies?

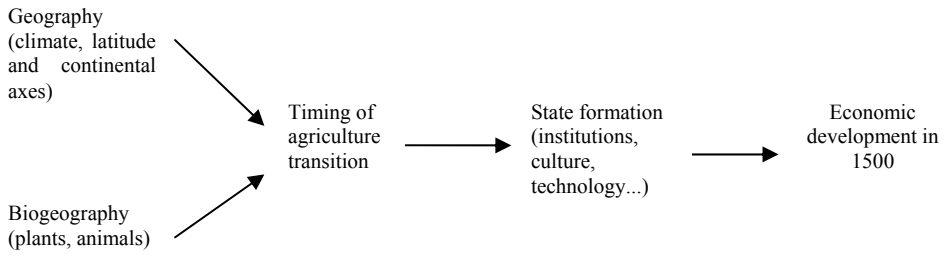
The early starts hypothesis is theoretically based on the argument used by Jared Diamond who, in *Guns, Germs and Steel*, argued that "the striking differences between the long-term histories of peoples of different continents have been due not to innate differences in the peoples themselves but to differences in their environments" (Diamond, 1997, p. 405). According to Diamond's hypothesis, differences between populations with respect to the timings of their transitions from hunter-foragers to agricultural societies, led to differences in the development of technologies and social organization that persisted through to the modern era, thus explaining the Europeans' colonial expansion. From this viewpoint, it was not genetic differences between populations, but favourable geographic and bio-geographic conditions that determined the Neolithic Revolution in Eurasia, thus creating a long-lived technological advantage for the Europeans' dominance over non-European populations.

The effect of bio-geography on economic development has been empirically investigated by Hibbs and Olsson (2005), who suggested that bio-geographic endowments had a crucial role in the timing of the transition to agriculture. Since the food surplus produced by agriculture made the establishment of a non-food production sector possible (and a progressive specialization of labour), which promoted knowledge and technological formation, the regions which started large scale agriculture adoption early benefited from an initial advantage over other less-endowed regions. Hibbs and Olsson (2004, 2005) demonstrated that some geographical and bio-geographical factors predict the dates of a transition to agriculture, and that these dates are a strong predictor of current income: according to their estimates, 52% of the variation of income per capita in 112 nations in 1997 was explained by differences in time since the transition.

[4] Recent archaeological research shows that also in the Sahara and in some West-Africa areas there is evidence of domesticated plants and animals dating back to the fifth and eighth millennia BC. MacEachern (2006).

Chanda and Putterman (2007) and Putterman (2008) have proposed that an early start development, leading to higher population density, labour division, and cities and social and political organizations, conferred long-lived economic advantages to societies in terms of social organization, technological knowledge and capabilities. To test this idea, they constructed an index of the history of States that, for present-day countries, measures the antiquity of the political organizations above the tribal level, such as kingdoms, empires or nations, from the year 1 AD to 1500, and demonstrated that the antiquity of and with states is correlated both with the estimated years since agriculture transition, urbanization, population density and per capita GDP in the year 1500. These findings, that show the long-lasting effects of history on economic development, suggest how favourable initial geographic and biogeographic conditions, determining the different timing of agriculture transition and differential social and institutional evolution, played a crucial role in explaining international differences in living standards before the colonial era. From this viewpoint, not genetic differences in intelligence between populations, but a more complex historical process, in which geographic, institutional and, of course, cultural factors all interacted to influence the nation's race towards prosperity. The "early start" hypothesis is schematically illustrated by Figure 2.

Fig. 2. The 'early start' hypothesis



3.2. Data and method

To test the relationship between IQ and economic development, I assumed Lynn and Vanhanen's (2006) logic, that is: if IQ is partly inheritable, and the

fundamental cause of the prosperity of nations, then the currently observable relationship between intelligence and economic development, should also have been found, to some extent, in the past.

To measure the development of nations in the past I have used data on urbanization rates and population density for circa 1500, from which GDP per capita estimates are derived. The data for 1500 respond to our purposes: in that epoch, the map of the world was very different from today. It was in the successive three centuries, in fact, that colonization, the slave trade, mass migration and, of course, the Industrial revolution, dramatically reshaped the map of poverty and prosperity among nations. In other words, the data for 1500 appear suitable to test whether the intelligence of populations can be proposed as a *cause* of development disparities or whether national IQs are, instead, to some extent simply *related* to the processes of modernization which started at the end of the 18th century.

Data on urbanization, originally collected by Bairoch (1988) have been supplemented by Acemoglu, Johnson and Robinson (2001); population density estimates are taken from Chanda and Putterman's (2007) dataset, based on McEvedy and Jones's (1978) calculations. In contrast with Maddison's estimate of GDP per capita for 1500, available for only 31 countries, data on urbanization rates and population density are available for a much larger sample. It is important to note that, in the pre-industrial era, population density and urbanization rates are usually considered reliable indicators for approximating the development levels. In pre-industrial economies, in fact, the possibility of a large urban population required high agricultural production and developed transportation systems. In addition, in Malthusian economies, improvements in technologies generated only temporary variations in income per capita, leading to larger but not wealthier populations (Ashraf and Galor, 2011b) .

In separate regressions, IQ-development link is also tested using, as a dependent variable, the indices of technological development calculated by Comin, Easterly and Dong (2010) for the predecessors of current nations, for the years 1000 BC, 0 AD and 1500 AD. This author found that technology in 1500 is associated with national income and technology adoption today. The level of

technology can be considered as a proxy of economic development: in our sample, the technology index in 1500 is correlated with urbanization rates (r = 0.43), population density (0.60) and per capita GDP (0.60) in the same year.

Average national intelligence is measured by IQs, provided by Meisenberg and Lynn (2011) for 168 nations, which updated the scores initially collected by Lynn and Vanhanen (2006). According to Lynn (2012), these current IQs can also be considered a reliable proxy of average intelligence quotient for the past. This assumption — that clearly stems from the hypothesis that IQ is largely heritable — may be valid for those nations which, throughout history, have not undergone significant demographic changes, but this does not hold for colonized countries, in which Europeans (and in a few cases Asians) replaced or interbred with indigenous populations, so determining possible changes in average intelligence. For these countries, that is all those of the Americas, Australia, Singapore, New Zealand and Papua New Guinea, the IQs of the indigenous populations reported by Lynn (2006, 2012) are used. For Australia, which now has a mean IQ of 99.2, the historic IQ is 62, that of the Aborigines. For Singapore, inhabited by Malays before the Chinese largely replaced the natives, the historic IQ is 92, but is currently 106.9. For Papua and New Guinea, an IQ of 63, that of the Aboriginal populations, is reported. For *all* the nations in the Americas the identical IQ of 86, that of the Native Americans, is assigned.

I too have taken these IQ scores, although some perplexities may arise regarding these data. For example, it is possible to note how, before the European conquest, the Amerindian populations reached very different degrees of socio-economic development. For example, North American natives lived in small, semi-nomadic, hunter-gatherer societies, while others, such as the Maya, Mexica (Aztecs) and Incas, lived in settled, complex and culturally advanced societies, with a relatively high degree of urbanization and population density. Other indigenous populations, such as the Yanomamo, the Trio, the Kayapó or others that

inhabit the Amazonian forest, lived (and in some cases still live) mainly at the stage of hunter-gatherers[5].

In the regression, two control variables are, separately, included. The first is Chanda and Putterman's (2007) State history index (State History) which, for present-day countries, measures the antiquity of the political organizations above the tribal level, such as kingdoms, empires or nations, from the year 1 AD to 1500. The second control variable is represented by the years since agriculture transition according to Putterman (2008), who provided data for 162 single countries, diversely to Hibbs and Olsson (2004) who originally estimated data for eight world macro-regions. Tab. 2 summarises the variables used in the analysis.

Tab. 2. Variables and sources

Variable name	Description	Sources
IQ	National average intelligence quotients of populations.	Meisenberg and Lynn (2011)
IQ historic	National average intelligence quotients of populations, including estimates of indigenous populations for the colonized countries.	Lynn (2012)
Urban1500	Urbanization rates estimated for 1500.	Acemoglu, Johnson and Robinson (2002) based on Bairoch (1998)
PopDens1500	Population density in 1500 (on total land area). In logarithms.	Chanda and Putterman (2007)
GDPpc1500ub	GDP per capita in 1500 extrapolated from urbanization. In logarithms.	Chanda and Putterman (2007)
GDPpc1500pd	GDP per capita in 1500 extrapolated from population density. In logarithms.	Chanda and Putterman (2007)
GDPpc1500both	GDP per capita in 1500 extrapolated from population density and urbanization. In logarithms.	Chanda and Putterman (2007)
State History	State Antiquity Index at 1500 AD.	Chanda and Putterman (2007) Variable: S1500n05
GDPpcMad	GDP per capita (in 1990 GK dollars) for various years. In logarithms.	Maddison (2010) On-line Dataset www.ggdc.net/maddison
Technology indices	Indices of technology adoption in the years 1500 BC, 0 AD and 1500 AD.	Comin, Easterly and Gong (2010)
Agric. Years	Years since agriculture transition. In logarithms.	Putterman (2008)

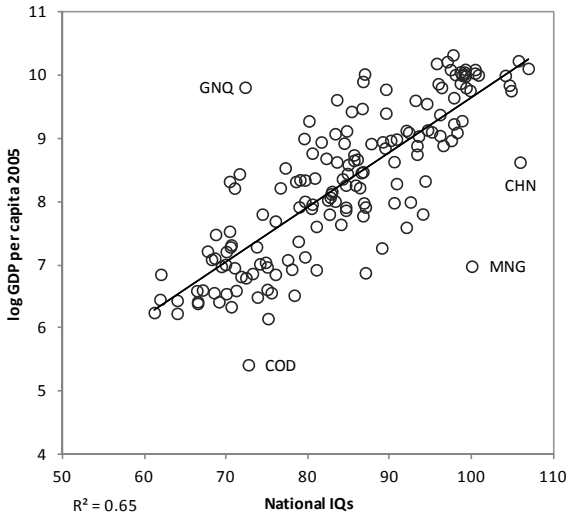
3.3. Economic development in 1500 and historic IQs

The relationship between IQ and development levels is, currently, very strong. Fig. 3 plots the link between contemporary national IQs and the log of GDP per capita in 2005 in 157 countries ($r^2 = 0.65$). It is possible to observe that there

[5] It is noteworthy that the latest research on the genetic history of American populations shows how the great majority of Amerindian peoples, from the Algonquin of Québec to the Yaghan of the Southern Cone, derive their ancestry from a homogenous 'First American' ancestral population, that crossed the Bering Strait more than 15,000 years ago. Nevertheless, researchers have documented the existence of two later-occurring streams of Asian gene flow into America, so rejecting the view that all present day native Americans stem from a single migration wave (Reich *et al*., 2012).

are some outliers. Equatorial Guinea (GNQ) has a considerably higher per capita GDP than that predicted on the basis of IQ (59 points); this notable discrepancy can be attributed to the boost effect of oil on national GDP. Mongolia (MNG) and China (CHN) have lower income levels with respect to their high IQ estimates (100 and 105.9, respectively). The Democratic Republic of Congo (COD) has the lowest income per capita according to Maddison's estimates.

Fig. 3. National IQs and GDP per capita



Note: GDP per capita (year 2005) and contemporary IQs. *Source*: IQs by Meisenberg and Lynn (2011) and per capita GDP from Maddison (2010).

Was this strong relationship between IQ and GDP per capita also valid in the past? Tab. 3 reports the results of the regression in which urbanization rates, population density and per capita GDP in the year 1500 are regressed on historic IQ and the State history variable. The results show clearly how alleged IQs are insignificant, while the State history predicts economic differences in 1500. Similar results are obtained when the development indicators for the year 1500 are regressed on IQs, controlling for the timing of agriculture transition (Tab. 4). Also in this case, the most ancient societies, in which agriculture started early, were those more developed in 1500, not those more "intelligent".

Tab. 3. Economic development in 1500, IQ and State history

	Urban1500	GDPpc1500ub	PopDens1500	GDPpc1500pd	GDPpc1500both
const	2.37	6.19**	0.0708	6.25**	6.08**
	(0.356)	(38.3)	(0.0573)	(63.3)	(29.5)
IQ historic	0.0175	0.00042	-0.0027	-0.0002	0.0007
	(0.218)	(0.218)	(-0.170)	(-0.170)	(0.304)
State history	9.78**	0.238**	2.87**	0.229**	0.383**
	(5.80)	(5.80)	(5.13)	(5.13)	(7.17)
n	61	61	106	106	61
R^2	0.30	0.30	0.29	0.29	0.47
lnL	-188	39.1	-190	77.9	31.6

Heteroskedasticity robust standard errors; t-statistics in parentheses; * indicates significance at the 10 percent level; ** indicates significance at the 5 percent level

Tab. 4. Economic development in 1500, IQ and the timing of agriculture transition

	Urban1500	GDPpc1500ub	PopDens1500	GDPpc1500pd	GDPpc1500both
const	-26.7**	5.49**	-10.5**	5.40**	4.77**
	(-4.38)	(37.1)	(-7.68)	(49.4)	(21.5)
IQ historic	0.0490	0.0012	-0.0036	-0.0003	0.0014
	(0.549)	(0.549)	(-0.267)	(-0.267)	(0.535)
Agric. years	3.63**	0.0881**	1.41**	0.112**	0.169**
	(5.26)	(5.26)	(6.87)	(6.87)	(5.80)
n	65	65	130	130	65
R^2	0.15	0.15	0.28	0.28	0.30
lnL	-204	37.4	-228	100	26.7

Heteroskedasticity robust standard errors; t-statistics in parentheses; * indicates significance at the 10 percent level; ** indicates significance at the 5 percent level

Tab. 5 reports the results of regression, in which the indices of technological development for the years 1500 BC, 0 AD and 1500 AD are regressed on IQ and the timing of agriculture transition. Lynn (2012) found a correlation of 0.42 between historic IQs and the level of technology in 1000 BC. Regressions indicated how there is no longer any link between historic IQs and technological development, once the years since agriculture transitions are taken into account. The link is, however, significant in the year 1500. This may be explained by the fact that the technology index in the year 1500 is correlated with the same index in the year 2000 ($r = 0.34$).

Tab. 5. Technological development in 1,000 BC, O AD, 1,500 AD and IQ

	Technology 1000BC	Technology O AD	Technology 1500 AD
const	-2.32**	-1.44**	-2.76**
	(-6.55)	(-7.06)	(-10.5)
IQ historic	0.0018	-0.0034*	0.0103**
	(0.805)	(-1.77)	(7.42)
Agric. years	0.316**	0.296**	0.287**
	(6.12)	(10.1)	(8.57)
n	110	133	113
R^2	0.44	0.32	0.62
lnL	13.3	7.04	27.7

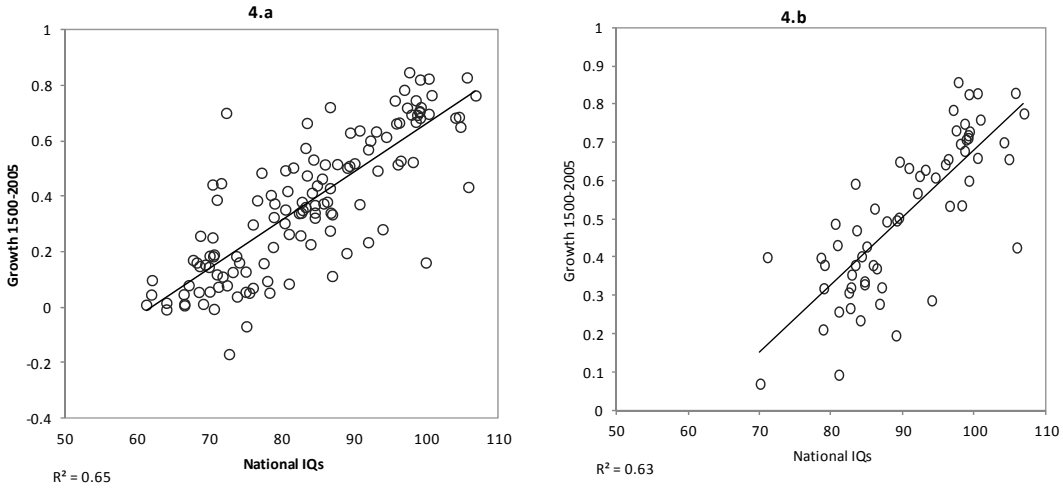
Heteroskedasticity robust standard errors; t-statistics in parentheses; * indicates significance at the 10 percent level; ** indicates significance at the 5 percent level.

Around 1500, Eurasian societies, had reached a degree of technological development that gave them an advantage in respect of other societies which, in the subsequent centuries, would become European colonies. This is consistent with Jared Diamond's explanation, but does not prove that Eurasian populations were genetically more intelligent. In fact, the differences in historic IQs do not explain the variations in technology before 1500 AD, as should happen on the basis of the logic underlying the theory of racial differences in intelligence.

3.4. Extrapolating the past from the present

One of the main arguments of the thesis on intelligence as a determinant of development, is that national IQs correlate significantly with long-run economic growth rates. Lynn and Vanhanen (2006), for example, report a significant correlation ($r = 0.71$) between IQs and rates of growth in the period 1500-2000. Fig 4 displays the relationship between current IQs and the average rates of growth of per capita GDP in the period 1500-2005. In graph (a) GDP per capita in 1500 is extrapolated from population density data, in graph (b) also from urbanization rates. As supposed, in both cases, a strong positive relationship exists.

Fig. 4. IQ and GDP per capita growth 1500-2005



Note: in graph 4.a *n* = 127, in 4.b *n* = 62. *Source*: GDP in 1500 from Chanda and Putterman (2007) and in 2005 from Maddison (2010).

Table 6 reports the correlations between the rates of growth in 1500-2005, national current IQs and GDP per capita in 1500 and other years. It is possible to see how growth rates are uncorrelated with per capita GDP in 1500.

Tab. 6. Correlations between GDP per capita rates of growth 1500-2005, IQ and GDP per capita

		1	2	3	4	5	6	7	8	9
1	IQ	1.00	0.09	0.11	0.81	0.79	0.26	0.50	0.60	0.81
2	GDPpc1500both		1.00	0.91	-0.14	-0.19	0.32	-0.04	-0.15	0.01
3	GDPpc1500pd			1.00	-0.09	-0.17	0.29	-0.13	-0.07	0.01
4	Growth1500-2005(a)				1.00	1.00	0.37	0.71	0.82	0.99
5	Growth1500-2005(b)					1.00	0.31	0.69	0.83	0.98
6	GDPpcMad1820						1.00	0.61	0.54	0.41
7	GDPpcMad1870							1.00	0.85	0.71
8	GDPpcMad1960								1.00	0.80
9	GDPpcMad2005									1.00

(a) GDP per capita in 1500 is extrapolated from population density; (b) GDP per capita in 1500 is extrapolated from population density and urbanization; number of observations: GDPpc1500both = 65; GDPpc1500pd = 143; GDPpcMad1820= 53; GDPpcMad1870 = 62; GDPpcMad1960 = 138; GDPpcMad2005 = 158.

Since, in 1500, the differences in living standards between countries were very small, the strong correlation between IQs and rates of growth does not offer any indication about the distribution of per capita income in 1500, but simply reflects the current relationship between income levels and IQs. Rich countries are rich because they have had comparatively higher historical rates of growth: consequently all variables (including IQs) related with current GDP levels are *ipso*

facto related to long-run growth. The correlation between rates of growth and per capita GDP in 1820 (0.37) suggests that the current world geography of development, which was not evident in 1500, commenced taking shape in 1820, when Industrial revolution began. Even if the different size of samples limits the comparability of coefficients, it is easy to see how the relationship between current IQs and income per capita significantly increased from 1820 onward: for the year 1820, when the great international divergence started, the correlation is 0.26, it increases to 0.50 for the year 1870 and reaches 0.60 in 1960.

4. Discussion

4.1. The results

The empirical analysis shows how, when data for urbanization, population density and derived estimates of income in the pre-industrial world are used, today's strong relationship between IQ and GDP per capita is no more robust. In addition, IQs do not predict the international differences in technology before 1500 AD. The differences in wealth – and, possibly, in technology and knowledge – appear, instead, related to the long-run patterns of social and institutional development, as measured by the State history index and by the timing of agriculture transition, not by alleged racial genetic differences in "general intelligence".

These findings are consistent with Diamond (1997) and Chanda-Putterman's (2007) arguments, that is that the transition from hunter-foragers to agrarian, complex societies, originally driven by geographic and environmental factors, determined long-term advantages in social evolution. With respect to hunter-foragers, large scale agrarian societies developed, over time, cumulative advancements in technology, knowledge and socio-institutional organization. Since social evolution is incremental, all these advancements posed the conditions for the gradual transformation of societies to agrarian-proto-industrial and then to industrial economies. The time of agricultural transition, and the antiquity of socio-political institutions above tribal level are, in fact, significant predictors of both development in the pre-industrial epoch (around 1500), and current income

disparities (Chanda and Putterman 2007; Putterman 2008, 2012). From this viewpoint, the process of economic development appears to be the result of initial environmental driving forces and cumulative secular social and cultural transformations. Since there is not a robust relationship between IQ and development prior to the Industrial revolution, it reasonable to suppose that other factors, not genetics, have determined the divergence in socio-economic conditions between nations.

Income growth is but one aspect of the profound changes brought about by economic development. In the process of development, schooling increases, child mortality shrinks and health conditions, including nutrition, improve. With modernization, social values are also transformed: the traditional, pre-scientific and irrational mindset is gradually abandoned and another, more scientific, rational and abstract diffuses. It is not unreasonable, therefore, to suppose that the average IQ of populations simply reflects the overall transformations caused by social and economic modernization. From a psychological perspective, some evidence and theoretical arguments support this view.

4. 2. IQ, economic development and the Flynn effect

In a study referring to 14 nations, Flynn (1987) observed notable IQ gains over time: these gains accounted for between 5 to 25 points in a single generation. Data on IQ trends are now available for 30 nations. These data show how IQ gains vary in relation to the degree of modernization of the diverse countries.

The size of the Flynn effect is, in fact, related to the stage of development countries, with more affluent ones showing lower IQ gains (Brouwers, Van der Vijver and Van Hemert, 2009). Countries that are starting the modernization process – such as Kenya and those in the Caribbean – exhibit very high increases in IQ scores (Daley *et al*. 2003; Meisenberg *et al*. 2005). In nations where modernization started during the early 20th century, such as Argentina, or at around the middle of that century, such as Brazil, large and persistent IQ gains are registered (Flynn and Rossi-Casé, 2012). In nations that industrialized during the 19th century, IQ scores are also increasing, although generally at a slower pace: the

trends suggest that IQ gains tend to reach an asymptote that could be represented by Sweden (Nisbett *et al*., 2012).

These trends suggest that, in a given time period, a negative relationship should exist - similar to the concept of economic convergence – between the "rates of increase" in IQs and the initial level of per capita GDP of countries or, alternatively, with the starting data of the modernization process. If this kind of convergence towards the IQ of more advanced countries continues in the future, the gap in IQ scores between nations will be gradually reduced until it disappears completely in about one century (Nisbett *et al*., 2012). This does not fit the theory of racial differences in IQ, according to which the intelligence gap between rich and poor nations is impossible to eradicate.

4.3. The effects of education and schooling

Several explanations of the Flynn effect have been put forward. Increased standards of living, that is in health, nutrition, education and mass media diffusion, have all been proposed as determinants of IQ gains (Barber, 2005). The estimates of national IQs, in fact, correlate highly with all the variables proposed as causes of the Flynn effect: the secondary enrolment ratio (0.78), pupil-teacher ratio (-0.72), the number of PCs per 1000 persons (0.66), the fertility rate (-0.86), urbanisation (0.67) (Wicherts and Wilhelm, 2007; Wicherts, Borsboom and Dolan, 2010a).

All these variables reflect the same phenomenon: the socio-economic development of nations, so it is not surprising that they are mutually inter-correlated. Some of these variables – such as higher education or a more stimulating cultural environment – can, however, also be considered proximate causes of IQ gains (Nisbett *et al*., 2012).

Education, in particular, has been shown to have a significant effect on the cognitive ability of individuals (Gustafsson, 2001). This effect was estimated by Winship and Korenman (1997), in the order of 2 to 4 IQ points for each additional year of schooling. Hansen, Heckman and Mullen (2004) have found that education increases the Armed Forces Qualification Test (AFQT) scores from between 2.79 to 4.2 points on average for each additional year of schooling. In a study referring

to Sweden, Falch and Sandgren Massih (2011), have estimated that one year of schooling increases IQ by 2.9-3.5 points. Further confirmation derives from research conducted in Norway by Brinch and Galloway (2012) which, examining the effects of a scholastic reform, found that an additional year of schooling increased IQ by 3.7 points. Finally, the changes in the educational curricula, particularly in the teaching of mathematics, can also explain the gains in fluid intelligence, measureable by Raven's progressive matrices (Blair *et al*., 2005).

4.4. The Flynn effect and IQ tests over time and across population

The significant IQ improvement over time, should lead us to suppose that our grandparents – that is the generations born in the first decades of XXth century – were, on average, considerably less intelligent than we are. For example, given the Wechsler-Binet rate of gain (0.30 points per year), the mean IQ of schoolchildren of 1900 would have been about 70 (Flynn, 2009). Americans (but analogous considerations could be made for Europeans) of the early 20th century would therefore have to have been classified as mentally retarded, as should the African populations be today, on the basis of Lynn and Vanhanen's IQ scores: clearly, both are nonsensical considerations! The Flynn effect does not, in fact, imply that we are becoming "more intelligent", but that we are getting "smarter" at taking IQ tests, because today formal schooling and everyday life have made us familiar with logical and abstract thought (Flynn, 2009).

For these reasons, the comparison of IQ test scores over time (and over cultures), requires great caution (Marks 2010). For example, research in traditional societies, like those conducted by Alexander Luria (1976) with peasants in the remote areas of Uzbekistan in the '30s, or with the Kpelle and Wai in West Africa by Scribner (1977), shows that in traditional non-literate societies the reasoning pattern is markedly oriented towards concrete thinking, based on personal experiences, rather than abstract reasoning. In traditional societies, for example, solution rates for simple syllogisms are at most about 65%: a very low score. This is simply because abstract reasoning is strictly dependent on a specific cultural approach: as observed by Nisbett and Norenzayan (2002) the best predictor for

successful solutions in syllogism is, in fact, the Western style of schooling, which traditional societies rarely have.

Similar considerations could be made about Americans or Europeans born at the end of the 19th century. Before 1900, most of the citizens of present-day Western industrialized countries worked in agriculture and, in lesser numbers, in factories; they had very low educational levels or were largely illiterate; their world was largely concrete: the minds of people were not permeated by scientific language and they were not in the habit of reasoning beyond the concrete (Flynn, 2009). From 1950 onwards, there were already profound differences: schooling levels increased notably; the economic structures changed profoundly, with a notable shift from agriculture towards industry and then services; economies and societies began to require more and more highly-skilled jobs and more qualified workers. With modernization, largely realized during the XXth century, people have acquired a new mindset. In the words of Flynn (2010, p. 364), individuals: "now find it natural to classify things as a prerequisite to understanding; rather than tying logic to the concrete, people find it natural to take the hypothetical seriously and use logic on the abstract. Thus the huge score gains on Similarities (classification) and Raven's Progressive Matrices (logical sequences of symbols)".

Social and economic modernization has not involved all nations simultaneously. Nowadays, a number of nations in Africa and Asia have to start the race towards modernization. There are populations, such as the Aka and the !Kung of Africa, the Dani of New Guinea or the Yanomamo of Amazonia who, in many ways, live lives that are not so different to those of ancient hunter-gatherers, with radically different cultures to those of the West (Diamond, 2012).

IQ tests have been constructed in Western countries in the XXth century. It is very doubtful, therefore, that they can reliably measure something similar to *g* for *all* the populations of the globe, including those who still live in hunter-gatherer societies, or to prove the existence of differences in intelligence between populations that lived centuries or thousands of years ago, as assumed by the above mentioned evolutionary theories of race differences in intelligence (Marks, 2010; Wicherts, Borsboom and Dolan, 2010b).

5. Conclusion

This paper has examined the causal nexus between national IQ and economic development. The strong relationship between IQ and economic development which nowadays exists, does not hold true for the year 1500 or prior, on the basis of available data on urbanization, population density and derived GDP. The timing of transition to agriculture and the history of States, not "historic IQs", are significant predictors of economic and technological development before the colonial era. Neither can the strong correlation between current IQ and long-run growth be advocated to prove that the intelligence of a population *cause*s development. Since *current* IQs and *current* income are strongly related, it follows that IQ scores are, *ipso facto*, related to long-run economic growth.

The debate on the role of genes and environments in explaining populations' differences in IQ is one of the most controversial in psychology. Since, at the moment, there is no direct evidence of genes determining intelligence differences among populations (Nisbett, 2009; Hunt, 2012), the evolutionary theories of intelligence are based on indirect argument. The evidence advocated in support of these theories is mainly based on the existing correlations between present IQs and socioeconomic variables. It is possible to observe how these correlations do not, in themselves, demonstrate any causal nexus between race/population IQ and long-run economic development.

From a psychological perspective, the findings of this paper may be interpreted in the light of Earl Hunt's (2012) thesis, according to which the indicators of national intelligence, like average IQ scores, measure the ability of populations to use some "cognitive artefacts" necessary to participate in industrial and post-industrial societies, while "differences in national capabilities to use cognitive artefacts are due to differences in the extent to which nations provide the techniques and institutions for the development of individual cognition" (Hunt, 2012: 303). Effectively, as indicated by the Flynn effect, several environmental

factors related to socio-economic modernization do exert a strong effect on average IQ[6].

From an economic perspective, national IQ scores make sense if they are interpreted as a measure of human capital but, being related to the process of modernization, they can hardly be assumed to prove that differences in the average intelligence of populations due to genes are the root, exogenous cause of international inequalities.

[6] It is important to note how the large estimates of heritability of IQ *within* a population at the same point in time are perfectly consistent with large environmental and cultural effects on IQ among populations (Dickens and Flynn, 2001).

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