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ABSTRACT

Regional differences in IQ are presented for 12 regions of Italy showing that IQs are highest in the north and lowest in the south. Regional IQs obtained in 2006 are highly correlated with average incomes at $r = 0.937$, and with stature, infant mortality, literacy and education. The lower IQ in southern Italy may be attributable to genetic admixture with populations from the Near East and North Africa.

1. Introduction

Regional differences in per capita income are exceptionally large in Italy. The north is as prosperous as central and northern Europe, but the south is much poorer. The American sociologist Robert Putnam (1993, p. 4) has written that "To travel from the north to the south in the 1970s was to return centuries into the past… many lived in one- and two-room hovels; farmers still threshed grain by hand… transportation was provided by donkeys that shared their rocky shelters, alongside a few scrawny chickens and cats".

Statistics showing the differences in living standards between the rich north and the poor south in Italy became available in the mid-nineteenth century and these differences persist to the present day, as shown in Table 1. It is estimated that in 1861 per capita incomes were about 15–20% higher in the north than in the south (Peracchi, 2008). By 1911 "the north–south gap had widened appreciably: northern incomes were about 50 per cent higher" (Putnam, 1993, p. 158) and this difference persisted into the early 1960s (Lutz, 1962) and into the twenty first century (Tabellini, 2009). Numerous theories have been advanced to explain what has become known as "Italian economic dualism". An Italian economist has written that "there is a huge literature dealing with the so-called "questione meridionale" — the social, cultural and economic backwardness of southern Italy" (Felici, 2007, p. 1). Another Italian economist has written that "works dedicated to the southern question would fill an entire library but many of the economists' questions as to the size and causes of Italian economic dualism remain unanswered" (Toniolo, 1990, p. 159).

Despite the attention given to this question, no consensus has been reached on the answer. Some have raised the possibility that "socio-cultural factors" might be involved. Putnam believes that "the historical record, both distant and recent, leads us (like others) to suspect that socio-cultural factors are an important part of the explanation" (1993, p. 159). But what are these socio-cultural factors? Putnam favors the theory of low "civic trust" in the south as a crucial factor, but concedes that other socio-cultural factors are likely present. More recently, the Italian economist Guido Tabellini (2009) has proposed that "culture measured by indicators of individual values and beliefs, such as trust and respect for

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others, and confidence in individual self-determination" is a determinant of regional differences in economic development in Italy and western Europe.

1.1. IQ and income: individuals

In this paper it is proposed that regional differences in intelligence are the major factor responsible for the regional differences in Italy in per capita income and in the related variables of stature, infant mortality, and education. This hypothesis is derived from the extensive research showing that intelligence is positively related to income. This relationship holds at three levels of generality: among individuals, across regions within nations, and across nations. At the level of individuals, the classical study of the contribution of intelligence to differences in income is Jencks' (1972) *Inequality*. In this he estimated a correlation of 0.31 (corrected for attenuation to 0.35) between IQ and income for a white male non-farm American sample aged 25–65. He concluded that this is a causal relationship such that IQ differences make a significant contribution to differences in incomes. He also concluded that IQ has a heritability of about 50%, and therefore that genetic factors contribute to income differences.

Jencks' conclusions have been confirmed by a number of subsequent studies in the United States (e.g. Brown & Reynolds, 1975; Jencks & Phillips, 1998; Crouse, 1979; Bishop, 1989; Herrnstein & Murray (1994); Neal & Johnson, 1996; Murray, 1997, 1998; Zax & Rees, 2002; Zagorosky, 2007), and also in Sweden (Zetterberg, 2004). An analysis of eight studies of the relation between intelligence and income concluded that the correlation is 0.27 (Ng, Eby, Sorensen & Feldman, 2005). In a recent meta-analysis of 85 data sets drawn from the United States, the United Kingdom, Norway, Australia, New Zealand, Estonia, Netherlands and Sweden, Strenze (2007) concluded that in all studies the correlation between intelligence and income is 0.20, in the best studies the correlation is 0.23, and in 35–78 year olds the correlation weighted by sample size is 0.25. This meta-analysis did not include a recent study of a national sample in Britain in which a correlation of 0.37 between IQ obtained at the age of 8 years and income at the age 43 years was found for men, and for women the correlation was 0.32 (Irwing & Lynn, 2006).

The positive correlation between IQs in childhood and income in middle age suggests that IQ is causal to subsequent income. This has been confirmed by studies of sibling pairs that have shown that siblings with higher IQs have higher earnings than their lower IQ brothers and sisters (Bound, Grilliches, & Hall, 1986; Rowe, Vesterdal, & Rodgers, 1999; Murray, 2002). The use of sibling pairs controls for possible family and neighborhood effects that might affect both IQ and income. The likely explanation for the positive correlation between IQ and income is that those with higher IQs work more efficiently (Schmidt & Hunter, 1998) and can supply goods and services with greater value than those with lower IQs, and consequently can command higher incomes.

1.2. IQ and income: groups

At a higher level of generality, positive correlations between IQ and per capita income have been reported for populations in geographical regions within countries. Studies

Table 1
Descriptive statistics for IQs and related variables for Italian regions.

Region	Reading	Math	Science	Mean education	IQ	Stature 1855	Stature 1910	Stature 1927	Stature 1980	Per cap income 1970	Per cap income 2003	Infant mortality 1955–7	Infant mortality 1999–02	Literacy 1880	Years educ 1951	Years educ 1971	Years educ 2001	Latitude
Friuli-Venezia	519	513	534	522	103	165.3	167.4	171.7	178.0	8985	20,750	38.3	2.50	45.9	5.2	5.7	9.0	46.0
Trentino	508	508	521	512	101			169.2	177.1	10,930	23,079	44.9	3.47	45.9	5.1	5.7	8.9	46.0
Veneto	511	510	524	515	101	164.8	167.1	169.0	177.0	9223	20,338	36.7	3.17	–	4.6	5.3	8.8	45.5
Tuscany	–	–	–	–	–	163.7	166.2	169.8	175.8	10,022	19,666	35.2	3.24	38.1	4.4	5.2	8.6	43.5
Lombardy	491	487	499	492	100	162.5	166.2	168.1	175.2	11,693	22,639	45.4	3.61	63.0	5.2	–	–	45.0
Piedmont	506	492	508	502	100	162.1	167.0	168.9	175.3	10,964	20,519	–	3.86	67.8	5.1	5.5	8.6	45.0
Liguria	483	473	488	481	97	163.2	167.7	169.7	175.1	9517	20,000	40.8	4.05	55.5	5.1	5.9	9.0	44.5
Emilia Romana	496	494	510	500	100	163.4	166.6	169.2	175.4	10,058	22,439	36.2	3.73	52.2	4.6	5.2	8.7	44.5
Umbria	–	–	–	–	–	161.9	164.6	167.2	175.8	7815	17,070	39.8	3.76	28.6	4.1	4.9	8.7	43.0
Lazio	–	–	–	–	–	161.8	164.6	167.6	175.5	10,317	20,207	–	–	41.8	4.8	5.8	9.4	41.5
Abruzzi Basilicata	446	443	451	447	92	159.6	162.8	164.2	174.0	6814	15,480	68.1	4.56	18.1	3.8	4.6	8.5	41.0
Campania	438	436	442	439	90	160.2	162.9	164.9	173.1	6481	11,862	62.2	5.21	24.6	3.6	4.7	8.2	40.5
Puglia Arulia	440	435	447	441	91	159.7	163.1	164.3	173.3	6313	12,030	70.4	5.88	20.0	3.4	4.5	8.0	40.0
Sardinia	435	429	449	438	90	158.5	160.6	162.1	171.6	8054	13,722	53.6	4.10	19.1	3.4	4.6	8.2	40.0
Calabria	–	–	–	–	–	158.3	162.2	163.3	172.4	6128	11,595	117.5	5.54	14.6	3.5	4.5	8.0	39.0
Sicily	424	423	433	427	89	160.2	163.3	164.7	172.7	6525	12,488	57.0	6.62	19.1	3.5	4.5	8.0	37.0

reporting this have been published for the British Isles, France, and the United States. The first of these studies was concerned with IQ differences in 13 regions of the British Isles in the mid-twentieth century (Lynn, 1979). It was found that the highest IQ (102.1) was in London, and the lowest IQs in Scotland (97.3), Northern Ireland (96.7), and the Republic of Ireland (96.0). These regional IQs were positively correlated with per capita income at 0.73. They were also positively correlated with intellectual achievement indexed by fellowship of the Royal Society ($r=0.94$), and negatively with infant mortality ($r=-0.78$) (Lynn, 1979). It has been shown subsequently that these regional differences in IQ are strongly associated negatively with differences in stature (Boldsen & Mascie-Taylor, 1985).

Similar results have been found in France, where regional differences in intelligence were reported for the mid-1950s by Montmollin (1958). IQs were obtained from 257,000 18 year old male conscripts into the armed forces, and mean IQs were given for the 90 French departments. The highest IQs were obtained by conscripts from the Paris region and the lowest by conscripts from Corsica. As in the British Isles, it was shown that these departmental IQs were moderately well positively correlated with average earnings ($r=0.61$), with intellectual achievement indexed by membership of the Institut de France ($r=0.26$), and negatively with infant mortality ($r=0.30$) (Lynn, 1980).

An association between regional IQ and per capita income has also been reported in the United States. It has long been known that in the United States the populations of the northern states have higher average IQs than those of the south east (Kaufman, McClean, & Reynolds 1988). This has been confirmed by McDaniel (2006a) who has calculated the IQs of the populations of the American states and found that these are highest in the north eastern states of Massachusetts (104.3), New Hampshire (104.2) and Vermont (103.8), and lowest in the southern states of Mississippi (94.2) and Alabama (95.7), and in California (95.5). The McDaniel (2006a) average state IQs are positively correlated with gross state product per capita (a measure of per capita income) at Pearson's $r=0.28$. These state differences in average IQ are partly determined by the proportions of blacks and Hispanics, who have lower average IQs than Europeans at approximately 85, 89, and 100, respectively (Lynn, 2006). McDaniel (2006a) calculated that state IQs are correlated at −0.51 with the percentage of blacks and −0.34 with the percentage of Hispanics. Similar state differences in IQ using a different methodology have been reported by Kanazawa (2006). The different methodologies are discussed by McDaniel (2006b).

At a third level of generality, positive correlations between IQ and per capita income have been reported across nations at a magnitude of approximately 0.7 (Lynn & Vanhanen, 2002, 2006). This finding has been confirmed in studies that have re-examined the data using alternative measures of per capita income (Barber, 2005; Dickerson, 2006; Whetzell & McDaniel, 2006; Templer & Arikawa, 2006; Hunt & Wittmann, 2008; Gelade, 2008), and by studies that have used national scores in math, science, and literacy as proxies for intelligence (Rindermann, 2007, 2008; Hunt & Wittmann, 2008). The positive correlation between IQ and per capita income across populations is to be expected from the correlation among individuals, because populations are aggregates of individuals, and populations with higher IQs can supply goods and services with greater value than those with lower IQs, and hence command higher incomes.

In this paper we examine the possibility that the north–south difference in per capita income in Italy may be due to differences in intelligence. There is some existing evidence suggesting this may be the case. In northern Italy, Prunetti (1985) has reported a standardization of the Colored Progressive Matrices on 500 6–11 year olds in Pisa and the surrounding countryside, and Tesi and Young (1962) have reported a standardization of the Standard Progressive Matrices on 2462 11–16 year olds in Florence and the surrounding countryside. Both studies found that the mean IQ in northern Italy is approximately the same as in Britain and other countries of northern and central Europe. It has not proved possible to find normative data for IQs in the south of Italy. However, Peluffo (1962, 1964, 1967) has reported that the cognitive development of children in southern Italy and Sardinia (one of the poorest regions and part of the south) lags behind that of children in Genoa in northern Italy and in Switzerland in the performance of Piagetian tasks of the understanding of conservation and causality. For example, 65% of 9 year olds in Genoa succeeded in the conservation of volume task, compared with only 35% of 9 year olds in the south. Piagetian tasks can be regarded as tests of intelligence. A correlation between the two of 0.49 is reported by Jensen (1980, p. 674) as the average of 14 studies.

The present paper examines three hypotheses. First, that IQs in Italy are higher in the north than in the south. Second, that these IQ differences explain most of the per capita income differences. Third, that regional IQ differences in Italy are also manifest in variables that can be regarded as correlates or effects of IQs, including stature, infant mortality, literacy, and years of education.

2. Method

Data have been assembled for 12 Italian regions for mean IQ, average per capita income in euros for 1970 and 2003 given by the Italian Statistical Office (2008), percentages of the populations that were literate in 1880, taken from Tabellini (2007, 2009), statures of military conscripts born in 1855, 1910, 1927 and 1980, taken from A'Hearn, Peracchi, and Vecchi (2009) and Arcaleni (2006), infant mortality 1955–57 and 1999–2002, taken from Felici (2007), years of education in 1951, 1971 and 2001, taken from Felici (2007), and latitude taken as the approximate geographical mid-point of the regions.

The regional IQs have been calculated from the 2006 PISA (Program for International Student Assessment) study of reading comprehension, mathematical ability, and science understanding administered to 15 year olds in 52 countries (OECD, 2007). Scores on these tests are used as a proxy for IQs, adopting the procedure that Rindermann (2007, 2008) has used for nations. The PISA reading test is a measure of verbal comprehension and the mathematics test is a measure of "quantitative reasoning", and both of these are major components of general intelligence (e.g. Carroll, 1993, p. 597; McGrew & Flanagan, 1998, p. 14–15), while science understanding is highly correlated with general intelligence (e.g. at 0.68 in the study by Deary, Strand, Smith, & Fernandes, 2007). More generally, numerous studies have shown that tests of

educational attainment are highly correlated with intelligence at around 0.5 to 0.7, reviewed in Lynn and Mikk (2007), and sometimes more highly, e.g. at 0.81 in a recent study of 70,000+ English children whose IQs were measured at the age of 11 years and educational achievement was measured at the age of 16 years (Deary et al., 2007). It has been shown that there is a strong genetic correlation between cognitive ability measured by tests of intelligence and educational, i.e. the same genes determine ability measured in both kinds of test (Bartels, Rietveld, van Baal, & Boomsma, 2002; Petrill & Wilkerson, 2000). These are designated "generalist genes" by Kovas, Harlaar, Petrill and Plomin (2005) because they determine many expressions of cognitive ability including IQs, math, reading, science, etc. The terms "intelligence" and "IQ" are used in this paper in the sense of the sum of all cognitive abilities or global IQ, as measured by intelligence tests such as the Wechslers and the Binets. The PISA tests measure some mix of *g* (Spearman's *g*, the general factor present in all cognitive abilities), gf (fluid intelligence or reasoning ability) and gc (comprehension/knowledge) but it is not considered possible to quantify the contributions of these three factors to the PISA scores.

To calculate IQs for the Italian regions the scores on reading comprehension, mathematic ability, and science understanding have been averaged and these averages have been expressed in standard deviation unit deviations from the British PISA mean (502, SD = 99). This gives scores for the Italian regions expressed in standard deviation units in relation to the British mean. These figures are then converted to conventional IQs by multiplying them by 15. Thus, the regional Italian IQs are expressed in relation to British mean IQ of 100, SD 15. Data are missing for Tuscany, Umbria, Lazio and Calabria.

3. Results

Descriptive statistics of the data are given in Table 1. The first column of Table 1 lists the regions in descending order of mean IQs. The region designated Lazio is sometimes referred to as Latium and consists of Rome and the surrounding countryside. Columns 2 through 4 give the mean scores of 15 year olds on reading comprehension, mathematics and science understanding for the Italian regions obtained in the 2006 PISA (Program for International Student Assessment) study. Column 5 gives the average of these three scores. Column 6 expresses these averages as conventional IQs in relation to a British mean of 100 (SD 15). Columns 7 through 10 give the statures of cohorts of military conscripts born in 1855, 1910, 1927 and 1980. Columns 11 and 12 give per capita income for 1970 and 2003 expressed in euros. Columns 13 and 14 give rates of infant mortality (deaths of infants in the first year of life) per 1000 births for 1955–1957 and 1999–2002 (Felici, 2007). Column 15 gives the percentage of the population that was literate in 1880 (Tabellini, 2007). Columns 16 through 18 give the average years of education in 1951, 1971 and 2001 (Felici, 2007). Column 19 gives the approximate latitude of the regions.

The inter-correlations between the variables are given in Table 2. Correlations higher than 0.38 are statistically significant at the 0.05 level (2-tailed), and correlations higher than 0.48 are statistically significant at the 0.01 level (2-tailed).

Table 2
Correlation matrix for variables in Table 1.

Measure	Reading	Math	Science	Mean educ	IQ	Stature 1855	Stature 1910	Stature 1927	Stature 1980	Income 1970	Income 2003	Infant mortality 1955–57	Infant mortality 1999–02	Literacy 1880	Years educ 1951	Years educ 1971	Years educ 2001
Math	0.993																
Science	0.993	0.994															
Mean educ	0.997	0.998	0.998														
IQ	0.993	0.991	0.990	0.993													
Height 1855	0.918	0.938	0.927	0.929	0.918												
Height 1910	0.906	0.897	0.877	0.894	0.902	0.929											
Height 1927	0.926	0.918	0.911	0.919	0.925	0.964	0.965										
Height 1980	0.936	0.953	0.936	0.944	0.933	0.939	0.868	0.919									
Income 1970	0.729	0.677	0.678	0.694	0.736	0.691	0.843	0.782	0.604								
Income 2003	0.914	0.914	0.908	0.913	0.937	0.815	0.841	0.842	0.821	0.934							
Inf Mrt 1955–7	−0.844	−0.834	−0.860	−0.847	−0.841	−0.775	−0.671	−0.716	−0.661	−0.684	−0.718						
Inf Mrt 1999–02	−0.867	−0.861	−0.883	−0.873	−0.861	−0.774	−0.666	−0.758	−0.807	−0.745	−0.826	0.670					
Literacy 1880	0.863	0.829	0.820	0.838	0.861	0.748	0.875	0.807	0.666	0.902	0.876	−0.661	−0.642				
Years educ 1951	0.922	0.899	0.893	0.905	0.929	0.820	0.901	0.894	0.830	0.889	0.936	−0.631	−0.765	0.924			
Years educ 1971	0.883	0.855	0.860	0.866	0.871	0.782	0.831	0.858	0.788	0.864	0.877	−0.642	−0.750	0.863	0.965		
Years educ 2001	0.886	0.880	0.878	0.882	0.886	0.721	0.685	0.761	0.796	0.774	0.850	−0.716	−0.868	0.689	0.862	0.908	
Latitude	0.970	0.961	0.956	0.964	0.963	0.863	0.874	0.870	0.875	0.798	0.899	−0.676	−0.897	0.842	0.888	0.802	0.726

4. Discussion

There are ten points of interest in the results. First, the IQ in the northern regions of Italy measured by the PISA data is approximately 100 and therefore about the same as in Britain and other countries of northern and central Europe given in Lynn and Vanhanen (2002, 2006). This confirms the results of the standardization of the Colored Progressive Matrices in northern Italy reported by Prunetti (1985) and shows that IQs measured by the PISA data and by the Colored Progressive Matrices data are consistent. Regional IQs in Italy decline steadily through the central regions and into the south and reach a low of 89 in the most southerly region of Sicily. The first hypothesis of this study that there may be a north–south gradient of IQs in Italy is supported and quantified by the correlation of 0.963 between regional IQs and latitude.

Two, the second hypothesis of this study is that the north–south gradient of IQs in Italy may explain much of the difference in economic development between the north and south of Italy. This hypothesis is confirmed by the correlation of 0.937 between regional IQs obtained in 2006 and per capita incomes in 2003. This correlation indicates that IQ differences explain 88% of the variance in per capita incomes across Italian regions. The 14 IQ point difference between the most northerly region of Friuli-Venezia (IQ = 103) and the most southerly region of Sicily (IQ = 89) can be compared with the 10.1 IQ point difference in the United States between the highest and lowest states (Massachusetts IQ = 104.3; Mississippi IQ = 94.2) (McDaniel, 2006), and the 8.1 IQ point difference in the British Isles between the highest (London and the south east IQ = 102.1) and the Republic of Ireland (IQ = 96.0) (Lynn, 1979). The large regional IQ differences in Italy help to explain the large regional differences in per capita income. It is proposed that these correlations between population IQ and per capita income arise through a positive feedback loop in which the population IQ is a determinant of per capita income, and per capita income is a determinant of the population IQ. Thus, the population's IQ is both a cause and a result of its per capita income. The population's IQ is a cause of its per capita income because individuals and populations with high IQs are able to work more efficiently than those with low IQs and consequently command higher incomes. The population's IQ is a result of its per capita income because populations with high IQs provide a better environment (better nutrition, health care and education) for the development of the intelligence of their children. This positive feedback loop is known in behavior genetics as genotype–environment correlation (Plomin, DeFries & McClearn, 1990).

Three, the third hypothesis we set out to examine is that regional IQ differences in Italy are also manifest in variables that can be regarded as correlates or effects of IQs, including stature, infant mortality, literacy, and years of education. This hypothesis is substantiated for all of these phenomena. Regional IQs are highly correlated negatively with rates of infant mortality in 1954–57 ($r = -0.847$), and 1999–2002 ($r = -0.873$). It is proposed that the explanation for these correlations is that populations with high IQs are more competent in looking after their babies, e.g. by avoiding accidents, and are able to give them better nutrition, which makes them healthier and more resistant to disease. An association between infant mortality and low IQ mothers has been reported by Savage (1946). These results corroborate studies showing that IQ is negatively related to mortality over the life span (e.g. Batty, Deary, & Gottfredson, 2007; Batty, Deary,& Macintyre, 2007; Batty, Shipley, Mortensen, & Deary, 2008; Gottfredson, 2004).

Four, per capita incomes are also highly negatively correlated with rates of infant mortality in 1954–57 ($r = -0.652$), and 1999–2002 ($r = -0.823$). It is proposed that the principal explanation for these correlations is that populations with higher per capita incomes have higher IQs and this is the main reason why they have lower infant mortality, as argued by Gottfredson (2004).

Five, the ability of populations with high IQs to give their children better nutrition makes them healthier, more resistant to disease and reduces the risk of mortality, and also improves their children's stature. This brings about the high correlations between regional IQs and the statures of cohorts of military conscripts born in 1855 ($r = 0.918$), 1910 ($r = 0.902$), 1927 ($r = 0.925$), and 1980 ($r = 0.933$). Positive correlations between IQ and stature of around 0.25 at the level of individuals have been reported in a number of studies (Paterson, 1930; Stoddard, 1943, p. 200; Laycock & Caylor, 1965). An extensive review of the evidence for the positive effect of the quality of nutrition on IQs is given in Lynn (1990) and confirmed by Benton (2001) and Arija, Esparo, Fernandez-Ballart, Murphy, Biarnes (2006). This is a corroboration of the positive feedback loop in which the population IQ is a determinant of the quality of nutrition received by children, and the quality of nutrition received by children improves the children's IQs.

Six, regional IQs in 2006 are highly correlated with the years of education of adults in 1951 ($r = 0.929$), 1971 ($r = 0.871$) and 2001 ($r = 0.886$). The likely explanation for these high correlations is that the populations with higher IQs keep their children at school longer. This improves the IQs of the children. The positive effect of years of education on IQ has been shown in numerous studies recently reviewed by Cliffordson and Gustafsson (2008). However, the regional differences in years of schooling amount to only about one year and it is estimated that this raises IQ by about 2.5 IQ points (Cliffordson & Gustafsson, 2008). Hence regional differences in years of schooling do not account for much of the 14 IQ point difference between the highest and lowest IQ regions. The positive relationship between regional IQs and years of education is best envisioned as another positive feedback loop in which the population IQ is a determinant of the amount of education received by children, and the amount of education received by children is a determinant of their IQs.

Seven, there is a high correlation between contemporary regional IQs and the percentage of the population that was literate in 1880 ($r = 0.861$). The likely explanation for this high correlation is that the percentages of the population that were literate in 1880 was a function of IQs and therefore that the regional differences in IQs were present in 1880 and have been stable over the period 1880 to 2006. This inference is confirmed by the high correlation between contemporary IQs and the statures of cohorts of military conscripts born in 1855 ($r = 0.918$). Stature is a function of nutrition, which is itself a function of IQ.

Eight, it is an interesting question whether the differences in Italian regional IQs were present in earlier historical periods. Some useful data bearing on this question have been

Table 3
Numbers of "significant figures" in science born in Italian regions from Murray (2003).

Region	1400–1600	1600–1800	1800–1950
North	62	76	49
Center	8	18	6
South	3	5	9

assembled by Murray (2003, pp. 303–5) who has compiled the numbers of "significant figures" (i.e. those who have made significant contributions to science, literature, music and art) and their places of birth for the whole of Europe from the year 1400 to 1950. His figures for the north, center and south of Italy are shown in Table 3. The north lies north of the 42nd line of latitude, the center lies between the 41st and 42nd lines of latitude and includes Rome, and the south lies to the south of the 41st line of latitude and includes Naples. It will be seen that as early as the years 1400–1600 by far the greatest number of Italian "significant figures" have come from the north (62 out of a total of 73), and the north continued to produce many more "significant figures" from 1600 to 1800 and from 1800 to 1950. These results suggest that the north–south IQ gradient in Italy has been present since 1400 and can explain most of the income differences that go back many centuries.

Are other explanations possible for these regional disparities? Murray (2003, p. 357) has noted the greater numbers of significant figures from the north and writes: "Italy's largest city during the Renaissance was Naples, and yet Naples, along with the rest of southern Italy, has almost no significant figures at all. Why not? A plausible explanation is that for practical purposes Naples and southern Italy were not part of what we think of as Renaissance Italy. They were controlled by the Spanish Hapsburgs and were politically and culturally separated from the rest of Italy". This may not seem a wholly satisfying answer to the question of why "Naples and southern Italy were not part of what we think of as Renaissance Italy". Perhaps the true explanation for the dearth of "significant figures" from southern Italy is that the IQ was lower.

Nine, Putnam (1993, p. 159) and Tabellini (2007) have proposed that "civic trust" is a determinant of regional differences in economic development in Italy and in western Europe. In this connection it is interesting to note that Rindermann (2008) has shown that "interpersonal trust" is correlated at 0.49 with intelligence across 41 nations. It may be that IQ is a determinant of "civic/interpersonal trust" and this accounts for the relationship between civic trust and economic development in western Europe found by Tabellini (2009).

Ten, we consider finally the how the regional differences in IQs in Italy can be explained. The regional differences in IQs in the British Isles and France can be reasonably explained by a tendency of the more intelligent in the poorer regions to have migrated over the course of centuries from the provinces to London and Paris, for which evidence is given in Lynn (1979, 1980). This would have raised IQs in the capital cities and reduced IQs in the provinces. In the United States also there has been migration from the poor south to the more affluent north that has likely been selective. It is probable that something similar has occurred in Italy, although most of the migration from the poor south was to the rich north rather than to Rome which is situated in the center of Italy. Putnam (1993, p. 139) describes migration from the south from the 1890s onwards as "substantial" and states that between 1958 and 1963 approximately 7% of the population of the south migrated to the north. Some political scientists have considered the possibility that outward migration from the south could have been selective. For instance, Putnam (1993, p. 239) writes that "it could be argued that selective migration could account for the backwardness of the south" although he does not mean selective migration for intelligence but for "civic mindedness" which he considers the crucial advantage of the northern population.

However, it was not until the 1890s that outward migration from the south became substantial (Clark, 1984), but the north–south differences in per capita income were present before then and go back centuries (Toniolo, 1990). The north–south differences in IQ also appear to have been present before substantial migration from the south to the north, if the percentages of the populations that were literate in 1880 are adopted as a proxy for IQ, while Murray's data on the far greater numbers of high IQ "significant figures" from northern Italy as early as the period 1400–1600 given in Table 3 suggest that the higher IQ of the north predated by several centuries the mass migration from south to north.

A possible explanation for the northern regions having had higher IQs than the southern regions at least from 1880 and possibly from 1400 to 1600 is that the populations of the north and south are genetically different and these genetic differences are related to differences in intelligence. Both intelligence and educational attainment are strongly determined by the same genetic factors (Bartels et al., 2002; Petrill & Wilkerson, 2000; Kovas et al., 2005), and where there are large population differences in intelligence and educational attainment there is a probability that genetic factors are involved. In the case of Italy, it is known that the populations of the north and south differ genetically. Cavalli-Sforza, Menozzi, and Piazza (1994) are the leading authorities on the genetics of human populations, particularly those in Italy. They write of the population genetics of Italy that "northern Italy shows similarities with countries of central Europe, whereas central and southern Italy are more similar to Greece and other Mediterranean countries. This corresponds to the well-known differences in physical type (especially pigmentation and size) between the northern and north-central Italians on the one side and southern Italians on the other" (1994, p. 277). By "Mediterranean countries" Cavalli-Sforza, Menozzi and Piazza mean the countries that border the Mediterranean including those of North Africa and the Near East. They note also that the Sardinians are genetically more closely related to the Greeks, Lebanese and North African Berbers than to central and northern Europeans (Cavalli-Sforza et al., 1994, pp. 78, 274). Subsequent studies have confirmed the genetic impact of immigration from the Near East and North Africa into southern Italy. For instance, the Taql, p1 2f2-8-kb allele has a high frequency in the Near East and North Africa (Morocco, 81.8; Lebanon, 43.7; Tunisia, 34.1). The allele is also present but at a lower frequency (26.4) in southern Italy, including Sicily. The frequency of the allele falls to 14.1% in central and northern Italy, but the allele

is rare at 3.8% in France and 3.5% in the Netherlands (Semino, Passarino, Brega, Fellous, & Santachiara-Benerecetti, 1996). A similar gradient is present for the pYα1 allele which has a high frequency in North Africa represented by Egypt (85.0), a lower frequency in southern Italy (includes Sicily and Sardinia) (70.5), falling to 51.4 in north-central Italy, and falling further to 33.0 in England (Mitchell, Earl, & Fricke, 1997).

The explanation of the genetic difference between northern and north-central Italians and southern Italians together with Sardinians is that over the course of many centuries there has been considerable immigration into the southern Italian mainland, Sicily, and Sardinia by peoples from North Africa and the Near East. Around 750 BC the Phoenicians and later the Carthaginians from North Africa colonized all these southern Italian regions (Aubet, 2001; Marston, 2002). Later, "Arabs occupied Sicily, Sardinia and Southern Italy in the seventh to the ninth centuries" (Cavalli-Sforza et al., 1994, p. 261). Sicily was ruled by Arabs from North Africa until 1060 and "during and after the Arab conquest, large Arab immigration took place" (M.M.C., 1960, p. 608). Arab rule ended in 1060 when Sicily was conquered by the Normans, but the Arab occupation left a genetic footprint. These results have been further confirmed by Zalloua, Platt, El Sibai, and Khalife (2008) who report genetic similarities between male Phoenicians (from present day Lebanon) and males in the populations of Sicily, Sardinia, and the far south of mainland Italy.

The diffusion of genes from the Near East and North Africa may explain why the populations of southern Italy have IQs in the range of 89–92, intermediate between those of northern Italy and central and northern Europe (about 100) and those of the Near East and North Africa (in the range of 80–84) (these IQs are given in Lynn, 2006). This also explains the north–south gradient of IQ in Italy in which the regional IQs do not show a clear dichotomy between north and south but rather a gradient in which IQs decline steadily with more southerly latitude. This gradient is shown by the latitudes of the regions given in the right hand column of Table 1. Here we see that the two most northerly regions of Friuli-Venezia and Trentino have the highest IQs (the same as those in central and northern Europe), and that regional IQs decline progressively with latitude to the five most southerly regions of Abruzzi Basilicata, Puglia Arulia, Campania, Sardinia and Sicily, which have the lowest IQs (89–92). This gradient is quantified by the correlation of 0.963 between latitude and IQ given in Table 2, suggesting that 93% of the variance in IQs across Italian regions is explained by latitude. The proposed explanation for this gradient is that with increasingly higher latitude the proportion of the Italian population with European ancestry and high IQs increases steadily until in the far north the IQ reaches the average (100) of the populations of central and northern Europe. This explanation also accounts for the IQs of around 90 for several countries in the Balkans shown in Lynn (2006) and confirmed for Serbia by Rushton and Čvorović (2009), whose populations are of partly European and partly Near Eastern origin (Semino et al., 1996). All these data taken together indicate that the north–south gradient of intelligence in Italy has a genetic basis going back many centuries, and hence predicts the social and economic differences documented in the nineteenth century up to the present day.

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