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Economic, educational, and IQ gains in eastern Germany 1990–2006

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ABSTRACT

Lynn and Vanhanen (2012) have convincingly established that national IQs correlate positively with GDP, education, and many other social and economic factors. The direction of causality remains debatable. The present study re-examines data from military psychological assessments of the German federal army that show strong IQ gains of 0.5 IQ point per annum for East German conscripts in the 1990s, after the reunification of the country. An analysis of IQ, GDP, and educational gains in 16 German federal states between 1990 and 1998 shows that IQ gains had a .89 correlation with GDP gains and a .78 correlation with educational gains. The short time frame excludes significant effects of biological or genetic factors on IQ gains. These observations suggest a causal direction from GDP and education to IQ.

1. Introduction

In their recent review article, Lynn and Vanhanen (2012) present evidence from a multitude of studies that convincingly show that national IQs, based on national standardization studies of intelligence tests, such as Raven's matrices, correlate with a wide range of economic, social, and political phenomena, such as GDP, educational output, economic and political freedom, health, and religiosity. Lynn and Vanhanen explain these observations with a causal model in which geographic and climactic factors are proposed to account for differences in national IQs while IQ differences are proposed to explain most of the cross-national differences in economic and social conditions. However, the authors concede that economic and educational factors might exert a reciprocal causal effect on national IQs.

An alternative model to explain the abovementioned correlations is that economic factors act as the primus motor that affects access to education and national IQ as the last link of the chain. Compared to poor societies, wealthy societies have more resources for education, which is known to correlate highly with IQ. For example, in a study by Longman, Saklofske, and Fung (2007), the mean IQ of Americans with eight-year education or less was 86 while the respective figure for those with at least 16 years of schooling was 112. One of the main arguments for this model comes from IQ gains over time, "the Flynn effect". For example, there has been a gain of 3 IQ points per decade in the mean IQ of Americans from 1932 to 2002 (Flynn & Weiss, 2007). Changes in mean IQ over a few decades are unlikely to be based on biological and genetic factors. Social factors, such as level of education that contribute to mean IQ, may change more rapidly. Other factors that are associated with economic development and that may affect average cognitive performance include urbanization, nutrition, trend toward smaller families and better healthcare (Wicherts, Dolan, Carlson, & VanDerMaas, 2010).

The period for economic and educational progress is short in comparison to biological evolution, but long enough to make the analysis of the relationship between IQ, economics, and education complicated. Significant economic and educational progress usually requires decades, and IQ gains are likewise slow. A great number of contaminating variables may affect the comparison of test scores collected from samples in 1950s and 2010s, for example.

In a remarkable 1999 study that has not received due attention, military psychologists of the German federal army, Bundeswehr, compared the IQs of conscripts from eastern and western Germany (Ebenrett & Puzicha, 1999). Rapid economic and social development took place in eastern Germany in the

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1990s after the unification of the country. Genetic factors should have limited effects on differences between East and West Germans, while there were great differences in the social, economic and educational systems between the eastern and western states pre-1990. In the present study, a re-examination of Ebenrett and Puzicha's data was performed. The relationship between IQ, GDP, education and other social variables up to year 2006 was analyzed.

2. Conscript assessment: samples and methods

Germany had conscription for male citizens between 1956 and 2011. The psychological assessment of conscripts included tests of scholastic skills, such as reading and writing, as well as an intelligence test that consisted of a 1) matrix reasoning test, 2) verbal reasoning (word analogy) test, and 3) test of arithmetic skills (Ebenrett & Puzicha, 1999; Bundeswehr, 2012; an online practice test is available at the Bundeswehr site). In the 1990s, the test was a pencil and paper test taken in groups. The intelligence test was scored on a scale from one (highest) to seven (lowest score), with the mean of 4 and standard deviation of 1.

In the 1990s, roughly half of the young men served in the military. The mean age for conscripts participating in the assessment was 18 years, but the assessment could be postponed for medical or other reasons and taken between the ages 18 and 22. There were 357,000 conscripts in the 1974 birth cohort, 266,000 were from western Germany and 92,000 were from the east. Out of these young men, 287,000 were assessed as able to serve in the military. In 1992, roughly 99,000 men served in the civilian service due to conscious objection, 18,000 men served in the east and 81,000 in the west (Bundestag, 2001; Tobiassen, 2005; Zivildienst, 2002). Conscious objection was slightly more popular in the west than in the east. In a Bundeswehr survey from 1993, attitudes toward the army were more positive among East German youth and those planning a career in practical vocations than among West German youth and those wishing to study further (Kohr, Lippert, Maier, & Sauter, 1993).

There were 403,000 men in the 1980 birth cohort, 277,000 from the west and 126,000 from the east. Out of these, 303,000 were assessed as healthy and able to serve. In 1998, 137,000 men served in the civilian service, out of which roughly 29,000 served in the east (Bundestag, 2001; Tobiassen, 2005; Zivildienst, 2002). Overall, 235,000 conscripts, roughly 50,000 from the east, and 185,000 from the west participated in the psychological assessment of the Bundeswehr in 1992. In 1998, 248,000 conscripts, roughly 80,000 from the east and 168,000 from the west were tested (Ebenrett & Puzicha, 1999). Persons that had been granted the status of conscious objector or exempted for medical reasons from the service did not participate. All testees were between the ages 18 and 22. Test score did not affect the length of service time. In 1992, roughly 73% of the eastern draftees had completed only the basic 10-year school, while the respective figure for western draftees was around 47%. By 1998 these figures had drastically changed, 28% of the East German and 42% of the West German draftees had completed the basic compulsory education only(Ebenrett & Puzicha, 1999).

3. Educational and economic development after reunification

The changes in the educational background of the conscripts reflect the radical changes in the educational system of East Germany after the reunification. The educational system in the former German Democratic Republic (GDR) was different from the West German system mainly in the sense that significantly fewer students graduated from theoretically oriented secondary schools aimed at preparing students to enter universities. In addition, students were admitted to this type of schools based both on academic and political merits, such as active membership in the communist youth league (Pannier, 2008). However, the western system was implemented shortly after the unification of the country. In 1992, 33% of West German youth between the ages of 18 and 21 had diplomas (Abitur or vocational Abitur certificate) from schools granting admittance to universities while the respective figure for eastern Germany was 23%. By 1995, this difference had practically disappeared, the figure for the western states and eastern states indicated 37.5% and 34%, respectively (Destatis, 2004). The East German economy was based on socialism until 1990, and the GDP per capita was estimated to be roughly one third of that of West Germany. After the unification, there was swift economic growth and by 1998, the GDP of the eastern states had risen to 56% of the West German GDP (Destatis, 2012a).

4. IQ, educational, and GDP gains 1990–2006

Table 1 shows the rise in mean IQ scores, GDP, and education in German states between 1990 and 1998. The IQ score is based on figures from Ebenrett and Puzicha (1999; Fig. 3), and the original test scores (mean = 4, SD = 1) have been converted to IQ points (mean = 100, SD = 15). The figures for education show the percentage of youth with an Abitur certificate (Destatis, 2004; Schmidt, 1990). The year 1990 was chosen for the educational data because of the transit period in the school system in the early 1990s.

The annual IQ gain rate was 0.66 for eastern Germany and −0.16 for western Germany. The correlation between IQ and GDP was .79 in 1992 and .27 in 1998. The correlation between education in 1990 and mean IQ in 1992 was .51 but the correlation for education and mean IQ was −.33 in 1998. The correlation between IQ gain and GDP gain was .89, between IQ gain and educational gain .78, and between GDP and educational gain .89. However, within western Germany, the correlation between IQ gain and GDP gain was .03 and between IQ gain and educational gain −0.12. Thus, the strong correlations based on calculations involving all states mainly reflect the east–west divide and its gradual narrowing.

The negative correlation between mean IQ and education in 1998 across states obviously contradicts the abovementioned strong correlations between IQ gains and educational gains and implies that there are cross-state differences between graduates. Education in Germany is controlled by the states and not by the federal government and there are some differences in academic standards between states (Prenzel et al., 2008). Ebenrett and Puzicha (1999) calculated the mean IQs of the conscripts that had completed only the basic school (10 years of education or less) and that of conscripts that had attended any type of secondary school (more than 10 years of education).

Table 1
IQ, GDP, and educational gains in Germany 1990–1998.
IQ figures are from Ebenrett and Puzicha (1999), GDP and education figures from Destatis (2004, 2012a) and Schmidt (1990).

State	Pop. 1995	Conscript IQ 1992	Conscript IQ 1998	GDP 1992	GDP 1998	Diplomas 1990 %	Diplomas 1998 %	IQ gain	GDP gain %	Diploma gain %
Brandenburg	2.5	93	97	96	160	18	32	4	67	14
Mecklenburg-V	1.8	93	98	95	161	17	27	5	69	10
Sachsen	4.6	96	100	96	164	18	30	4	71	12
Sachsen-Anhalt	2.8	93	96	91	156	18	29	3	71	11
Thueringen	2.5	97	100	91	156	18	32	3	71	14
Former GDR	*14.2*	*95*	*99*	*94*	*161*	*18*	*30*	*4*	*71*	*12*
Baden-W	10.3	102	101	243	269	25	30	−1	11	5
Bayern	12.0	102	102	239	275	18	20	0	15	2
Berlin	3.5	100	98	202	227	25	31	−2	12	6
Bremen	0.6	98	96	278	317	27	31	−2	14	4
Hamburg	1.7	101	100	350	411	34	33	−1	17	−1
Hessen	6.0	99	101	256	286	26	30	2	13	4
Niedersachsen	7.8	100	98	198	218	22	26	−2	10	4
Nordrhein-W	17.8	100	99	221	245	24	29	−1	11	5
Rheinland-P	4.0	100	100	198	216	21	24	0	9	3
Saarland	1.1	99	99	199	220	17	22	0	11	5
Schleswig-H	2.7	101	101	202	226	21	25	0	12	4
Former FRG	*67.4*	*101*	*100*	*228*	*257*	*22*	*26*	*−1*	*13*	*4*

Population in millions. GDP in 100 € pro capita, diplomas = share of age cohort with 12-year Abitur diploma.

The figures converted to IQ scores are shown in Table 2. Table 2 also shows figures for two other factors that Lynn and Vanhanen (2012) have found to correlate with intelligence, namely geographic latitude (positive correlation) and religious beliefs (negative correlation). Contrary to Lynn and Vanhanen's hypotheses, geographic latitude (of the capital of the federal state) had a −.51 correlation with mean IQ and religiosity, as measured by church membership (Fowid, 2005), had a .33 correlation with mean IQ.

Table 2
Effect of education, religion and geographic latitude on IQ.
IQ and education figures are from Ebenrett and Puzicha (1999), and church membership from Fowid (2005).

State	Conscript IQ 1998	IQ 1998 secondary school	IQ 1998 basic school	Latitude degrees	Religiosity
Brandenburg	97	100	84	52	35
Mecklenburg-V	98	103	86	53	40
Sachsen	100	105	85	51	39
Sachsen-Anhalt	96	100	84	52	32
Thueringen	100	104	86	51	44
Former GDR	*99*	*103*	*85*	*52*	*38*
Baden-W	101	110	89	48	84
Bayern	102	111	92	48	89
Berlin	98	104	87	52	60
Bremen	96	106	86	53	92
Hamburg	100	108	88	53	61
Hessen	101	107	88	50	78
Niedersachsen	98	106	87	52	88
Nordrhein-W	99	107	85	51	88
Rheinland-P	100	107	87	50	94
Saarland	99	107	89	49	94
Schleswig-H	101	108	90	54	75
Former FRG	*100*	*108*	*88*	*51*	*84*

IQ secondary school = conscripts with >10 years of education, basic school = 10 years or less of schooling; latitude = latitude of state capital; religiosity = church membership % of adults, 2002.

Fortunately for German youth, but unfortunately for intelligence researchers, conscription became more selective toward the end of the 1990s, and each year, a smaller share of young men served. Therefore, the IQ data obtained after 1998 are unreliable. Table 3 shows figures from the international student assessment project PISA for scholastic aptitude among 15-year old pupils (Baumert et al., 2002; Prenzel et al., 2008; the city states Bremen, Berlin and Hamburg did not participate in 2000). The mean of three PISA subtests, mathematics, science and reading skills, was calculated and converted into IQ points. PISA results are known to have a high correlation with national IQs (Lynn & Mikk, 2009). Table 3 indicates that Germany as a whole progressed during 2000–2006 when compared to other

Table 3
PISA combined score and GDP 2000–2006.
GDP data are from Destatis (2012b), and PISA data are from Baumert et al. (2002) and Prenzel et al. (2008).

State	PISA IQ 2000	PISA IQ 2006	GDP 2000	GDP 2006	GDP gain %	IQ gain
Brandenburg	95	101	172	206	20	6
Mecklenburg-V	96	100	169	194	15	4
Sachsen	100	104	170	210	24	4
Sachsen-Anhalt	95	101	164	200	22	6
Thueringen	99	102	166	201	21	3
Former GDR	*98*	*102*	*169*	*202*	*20*	*4*
Baden-W	101	103	283	317	12	2
Bayern	102	104	297	332	12	2
Hessen	97	100	302	342	13	3
Niedersachsen	96	99	228	250	10	3
Nordrhein-W	97	100	252	278	10	3
Rheinland-P	98	101	226	247	9	3
Saarland	98	101	231	276	19	3
Schleswig-H	98	100	233	247	6	2
Former FRG	*99*	*101*	*269*	*296*	*10*	*2*

PISA mathematics, reading and science combined mean score in IQ point; GDP per capita in 100 €.

OECD countries. The PISA score of 500 equal to 100 IQ points represents the mean of all OECD countries. According to Weiss (2009) the inclusion of Turkey (with a fairly low PISA score) in the sample of reference in 2003 automatically raised the German score by 0.45 IQ points. However, eastern Germany made faster progress compared to the western states, both in PISA scores and in GDP. Subtracting 0.45 from the figures in Table 3 gives a pro annum gain of 0.26 IQ points for the west and 0.59 for the east. Correlation between GDP and PISA scores was moderate (r = .47) in the year 2000 but weak (r = .14) in 2006. The correlation between GDP gain and PISA gain was .67.

Presumably, educational expenditure is the mediating factor between GDP and educational attainment. As Table 4 shows, educational expenditure in 1995 per pupil was lower in eastern Germany than in the west, but by 2005 the situation had reversed. This may explain the fast IQ gain rates of eastern German youth. The West German city states Berlin, Hamburg and Bremen pose a problem with high GDP, high educational expenditure and stagnant or shrinking IQ. In 1998, conscripts from wealthy Bremen (GDP 31,700) had a mean IQ of 96 while those from the state surrounding Bremen, Niedersachsen (GDP 21,800) had a mean score of 98. In PISA 2006 the combined mean IQs for Hamburg, Bremen and Berlin were 99, 97 and 100, respectively, despite their higher than average educational expenditure. This has been explained by the high share of students from immigrant families (Prenzel et al., 2008). In 2003, 35% of the pupils in Bremen had at least one parent that was not German-born. The respective figure for the surrounding Niedersachsen was 24%, while the figures for the five East German states varied from 3.6 to 6.0. Children from immigrant families had much lower mean scores in PISA 2006 than children with German parents (Prenzel et al., 2008). Ebenrett and Puzicha (1999) do not report the share of conscripts from immigrant families, but census data indicates that it was probably higher in 1998 than in 1992 and this may have affected the stagnant IQ scores in West German cities. On the other hand, 1.3 million Germans moved from East to West Germany from 1989 to 2006, half of them younger than 25 years of age (Lehmann, 2008). The education level of these migrants was higher than that of the general population, with roughly one third of the early 1990s migrants having at least a high school diploma. The east–west brain drain has been an important political issue in unified Germany (Ebenrett, Hansen, & Puzicha, 2003). Arguably, IQ gains in eastern states would have been larger without the migration.

5. Conclusions

These results show a strong correlation between IQ, GDP, and education, confirming the observations made by Lynn and Vanhanen (2012). However, it is difficult to explain these correlations using biological or genetic factors because of the rapid changes occurring within a short time span. It is not reasonable to assume significant genetic or biological differences between East and West Germans in 1992 but not in 1998. Instead, social and political factors offer a simpler explanation. Great differences existed between East and West German societies before the unification in 1990 in terms of education, economics, politics, and religion. Due to political factors, such as lack of democracy and economic freedom, the East German economy did not perform as well as the West German one and offered fewer resources for education, which is known to have a strong effect on IQ. When the two societies started to merge in the 1990s, eastern Germany gained in GDP and the educational expenditure rose. The educational level of East German conscripts was significantly higher in 1998 than in 1992 resulting in robust IQ gains. By 2006, the effect of rising prosperity and educational expenditure on educational gains seemed to have reached saturation, with roughly equal student assessment results in the East and West, although a gap in the GDP levels remained.

Social, political and historical rather than neuropsychological factors can also explain the negative association between the latitude of the state capital and mean IQ and the positive correlation between church membership and mean IQ, findings that do not support the hypotheses of Lynn and Vanhanen. The geographical midpoint of the Soviet occupation zone was north of the British and US zones. The communist government of GDR favored atheism and discouraged religious practice. In Western Europe, catholic countries have been more resistant to secularization than protestant nations. In Western Germany, the predominantly catholic south is more religious than the predominantly protestant north.

Ebenrett and Puzicha's study on conscripts' IQs is unique because of a large sample size, which included more than half of individuals from each age cohort. The test methods had been validated on samples of millions of earlier conscripts. All participants spoke German. These factors render it unlikely that the IQ gains observed are an artifact of testing methods or sampling errors which are often potential problems in longitudinal and cross-national analyses (Wicherts, Dolan, & VanDerMaas, 2010a, 2010b). Moreover, it is unlikely that there was a radical change in the test motivation of the East German conscripts between 1992 and 1998 that might explain the results. Attitudes toward the compulsory military service were more favorable among East German youth than among West Germans (Kohr et al., 1993), and persons reluctant to serve in the military did not participate in the testing. The PISA studies, likewise based on very large samples, corroborate the finding of gradually diminishing east–west differences in cognitive skills of young Germans.

Table 4
Educational expenditure per pupil; primary and secondary schools. Figures are from Autorengruppe Bildungsberichterstattung (2010).

	1995	2000	2005
Former GDR	3700	4000	5000
Former FRG	4300	4300	4600
City states	5300	5200	5500

Expenditure in Euros. Former FRG excluding city states Berlin, Bremen, and Hamburg.

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