



Divergent historical experiences and inequality in academic achievement: The case of Poland

Mikolaj Herbst^{a,*}, Steven Rivkin^b

^a Centre for European Regional and Local Studies (EUROREG), University of Warsaw, Warsaw, Poland

^b Department of Economics, University of Illinois at Chicago, IL, United States

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ABSTRACT

Divergent histories and changing country boundaries can lead to substantial within country variation in economic and social structures and inequality in economic and social outcomes. Given its changing borders and turbulent history, Poland provides a fertile setting for an examination of the contributions of history-related factors to regional variation in economic and social outcomes. In this paper we focus on academic achievement and find that economic dislocation following the transformation from communism and the absence of long-lasting social institutions as a result of population relocation appear to have had substantial adverse effects on academic achievement in some regions. Regional differences in the economic return to education also appear to contribute to variation in academic achievement.

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1. Introduction

Borders change, at times dividing nations and at other times bringing together areas with divergent political, economic, and social structures under one flag. Such differences can lead to regional inequality in income, educational attainment, and other outcomes that persist well after unification and place pressure on central governments to redistribute resources toward less developed regions. Germany, the United States, and Italy provide prime examples of nations with sharp regional differences that have devoted substantial effort and resources to address inequalities resulting at least in part from divergent paths taken prior to unification as a single nation. Although much effort goes toward lessening regional income inequality, substantial attention is also devoted to the reduction of regional differences in educational opportunities and academic attainment in order to reduce future inequality.

Myriad factors explain regional differences in education outcomes including political, social and economic structures at the time of unification, the structure of government policies going forward, and economic conditions. Although many of these same factors also affect regional differences in per-capita income, somewhat surprisingly the relationship between educational attainment and income varies by country. Italy and the United States provide two examples of countries in which regions with better educational outcomes also tend to have higher per-capita income. In the case

of Italy, [Daniele and Malanima \(2011\)](#) found that the correlation between regional GDP and academic achievement is 0.92, and [Bratti et al. \(2007\)](#) show that there is a differential of almost one standard deviation in the average mathematical literacy PISA score between the higher income North-East and the lower income South. [Daniele and Malanima \(2011\)](#) do not believe that the evidence provides support for a particular causal explanation of the relationship, while [Bratti et al. \(2007\)](#) conclude that family, community and school resources explain roughly 75% of the gap, and difference in school effectiveness explain the rest.

In the case of the United States, [Parcel and Dufur, \(2009\)](#) show that regional differences in education performance tend to line up with average income differences.

However, the interdependence of economic performance and educational achievement is not the universal rule as illustrated by Germany. Despite a much lower level of per capita income, the east region outperformed the west region on the 2006 edition of the international PISA test. [\(Welt-Online, 2008\)](#). The processes that determine these respective outcomes are clearly complex, and the divergent histories of formerly East and West Germany certainly contribute to the pattern of outcomes today.

In this paper we investigate regional inequality in academic achievement in Poland, a country that also has experienced a turbulent recent history of dramatic changes in economic and social structures, reconfiguration of borders, and population resettlement. These have almost certainly contributed to geographic differences in income and economic growth ([Herbst, 2008](#)), labor market structure ([KPRM, 2009](#)), the development of roads, railroads, and telecommunication network ([MRR, 2009](#)) and politics

* Corresponding author.

E-mail address: mherbst@uw.edu.pl (M. Herbst).

(Zarycki, 2000), all of which are interrelated to differences in academic achievement.

Though Poland was not divided into two separate countries following WWII as was the case with Germany, its borders were reconfigured and there was substantial population relocation. Moreover, the intensity of agricultural collectivization and economic dependence on heavy industry varied significantly by historical region. Of particular interest to us are the roles played by regional differences in social and economic structures prior to WWII, the imposition of political and economic changes under communism, the post-communist transformation begun in 1989, and recent school reform efforts.

Since 1989 Poland has introduced a number of education reforms including a national standardized test for students in the 6th and 9th grades in 2002, school decentralization beginning in 1996, delayed tracking in 1999, and a restructuring of the secondary school network. Formerly subordinated to the central government, between 1996 and 1999 primary and secondary schools were granted greater autonomy and are now managed by municipalities and counties, respectively. The restructuring of the secondary school network contributed to a reduction in the share of students in vocational schools from 76% in 1990 to 56% in 2008 (Herbst, 2012). In 1999 tracking into vocational and general education path was delayed by introducing a new tier of education (lower secondary school) into a system that previously had eight years of primary school and three to five years of secondary education. The latter reform has likely played an important role in the remarkable improvement of Polish student achievement in the OECD administered PISA test between 2000 and 2009 (Haahr, 2005). Finally, the national standardized tests provide measures of mathematics and reading achievement, shown by Hanushek and Woessmann (2007) to be important determinants of economic growth. Although measures of education quantity such as years of schooling provide rough measures of the human capital stock, they fail to capture changes over time in school quality and other factors that affect the acquisition of knowledge. The development of standardized achievement tests in Poland that are comparable over time and administered and graded outside of schools provides an objective source of achievement data with which to investigate geographic differences in cognitive skills.

A small number of papers uses the national examinations to describe and examine geographic variation in achievement, and we use these findings as a starting point for our own work. Herbst (2006) suggests that regional differences in three factors account for much of the variation in test scores: resources (including educational attainment, family income and labor market conditions), the endowment of social capital, and the expected return to education. In earlier work, Herczyński and Herbst (2002) found that municipal average achievement is positively correlated with average educational attainment in the parents' generation and negatively correlated with the local unemployment rate. Importantly, the divergent historical experiences appear to contribute to variation in these two factors, suggesting that both recent and more distant historical experiences contributed to regional inequality in achievement.

Subsequent work has focused in large part on attempts to understand better the importance of particular historical events. Using the same data, Śleszyński (2003) observed that achievement was higher in the regions with a "stable and continuous" history of settlement and lower in the regions that experienced massive dislocation of population after World War II. The author also found a negative correlation between achievement and the unemployment rate and a positive correlation between achievement and civic engagement of the population (as measured by the election turnover), consistent with the notion that historical events that contributed to regional differences in economic

conditions and civic engagement also affected educational performance. Czapiewski and Śleszyński (2007) also highlight the importance of regional differences in historical experiences, with particular emphasis given to the socio-economic processes occurring after World War II. This paper also emphasizes the large urban-rural gaps in both achievement and economic development. Finally, Dzieciol-Kurczoba (2008) found that the inferences based on analyses of the national 6th and 9th grade examinations are consistent with patterns observed for upper secondary school (12th grade) examinations.

Although these papers found that the regional variation is consistent with certain explanations, the inter-related nature of historical events and consequent differences in social and economic structures complicate efforts to assign a specific role to each. Therefore in our work we adopt a somewhat different approach and focus on the relationship between academic achievement on the one hand and a set of current family, social, and economic factors that have been influenced by many historical events. Rather than treating history as a "black box" or a cultural "cloud" hanging over some territories (as it was the case in some previous papers), we attempt to identify the impacts of specific factors that themselves can be linked to particular historical influences. Importantly, the availability of multiple years of test score data enables the use of panel data methods to account for other regional differences that could contaminate the estimates.

Our findings suggest that economic dislocation following the 1989 transition and the absence of long-lasting social institutions as a result of population relocation have had longer-term adverse effects on academic achievement. They also show that achievement is significantly related to standard education production function variables including per-student expenditure, teacher qualifications, and parental income, illustrating specific policy levers that could be used to mitigate inequality resulting from the divergent historical processes.

In the next section we describe the various data sources used in the empirical analysis. Section 3 briefly describes the historical evolution of Polish regions and current regional differences in education and economic outcomes. Section 4 develops the empirical model used in the analysis of test scores, and Section 5 presents the results. This section also discusses the implications of the findings for particular hypotheses regarding the channels through which historical events have influenced geographic inequalities today. Section 6 summarizes the analyses and considers implications for education policy.

2. Data

The test scores and data used to construct the explanatory variables come from a number of sources. Test scores come from the Polish Central Examination Committee. Poland introduced its national testing system in 2002 with tests in grades six and nine and added grade twelve in 2005 (the 6th, 9th, and 12th grades are the final grades of the primary, lower secondary and upper secondary tiers, respectively). The test structure differs by grade: the sixth grade examination is a single test verifying basic cognitive skills; the test for lower secondary school leavers (ninth grade) is divided into math-science, humanities and foreign language parts; and the twelfth grade examination, after which students attain full secondary education, is divided into subjects, with the possibility of choosing the regular or extended versions of the test.

Because of a growing body of research that shows that schools have a larger effect on mathematics than on reading achievement and that mathematics achievement has a larger impact on wages, we focus on the ninth grade math-science test. We transform

the test score into a standardized score with a mean of zero and standard deviation of one in each year. Note that we use municipality populations to weight the municipality average scores in the construction of the standardized score.

Information on the explanatory variables comes from several sources. The data on the proportion of locally born residents among those born before 1945 and on educational attainment in the parents' generation (population 35–50 years old) is derived from the national census conducted in 2002. Because there is no more recent census information, the 2008 parental attainment variable was constructed from 2002 information on younger cohorts (aged 30–44). Consequently this variable does not account for the limited movements for this age group among regions or countries between 2002 and 2008. To account for the effects of selective migration into particular municipalities we use data on migration flows between municipalities averaged over eight years preceding the observed school tests (1994–2001 and 2000–2007 for the 2002 and 2008 tests, respectively) provided by the Polish Central Statistical Office. This office is also the source of information on per student expenditure, the local unemployment rate, and the proportion of the population living in rural areas. Finally, data on teachers' formal qualifications comes from the Ministry of Education SIO Database.

The research is performed at the level of the 2478 Polish municipalities for the years 2002 and 2008. The year 2002 was first year in which the nationwide achievement tests were administered, and 2008 is the most recent year for which all data are available. Although 9th grade's test scores are reported annually between 2002 and 2009, other important information is not available for most of this period. Therefore we limit our analysis to the two years. Most of the variables are available at the municipality level, though unemployment rate and educational attainment data are only available at the higher level of aggregation of 379 counties. This aggregation does not introduce bias in a linear model, and we adjust the standard errors accordingly by clustering at the higher level of aggregation.¹

3. Regional differences in Poland

This section begins with a description of the geography of Poland and a brief discussion of the divergent historical experiences of the different regions. It then describes current geographic variation in income and achievement as a first cut at understanding the potential importance of different historical processes and as a description of the variation to be used in the education production function analysis.

The recent history of the territories that make up Poland today reveals that the four historical regions illustrated in Fig. 1 took divergent paths to statehood and that the entire nation has undergone a series of profound social and economic changes following WWII. Although many focus on the impact of communist rule on current economic and social conditions, some sources also emphasize the importance of the period prior to WWI in understanding current geographic differences.² Regional differences at the onset of communist rule may well have influenced the nature of the communist imposition of economic and social structures in ways that affect the development following the transformation in 1989.

3.1. Brief history

Between 1772 and 1795, following a series of military defeats, Poland was divided among three neighboring powers – Russia, Prussia and Austria. This division took place in three stages and eventually involved the entire Polish territory. The territory under Prussian rule (post-Prussian region in Fig. 1) was the most developed part of Poland at the time of the partition, while the eastern territories under Russian rule were the least developed. Up until the reunification of Poland following WWI the three regions were exposed to very different political and administrative cultures and experienced markedly different rates of economic growth, with territories under Russian rule being generally less advanced economically and lagging in terms of the development of modern social and political structures.

Following WWII the Yalta agreement redefined Polish borders: Poland lost its easternmost territories to the Soviet Union and in compensation it gained some formerly German territories in the west and north-west. This resulted in the expulsion of the German population from the areas acquired by Poland and mass relocation of Polish citizens from the remaining parts of the country and the territories lost in the east to the west and north-west. Between 1945 and 1950 the inflow of population to the new territories in the west and north reached 2.9 million, 55% of which came from the areas ceded to the Soviet Union (Gawryszewski, 2005). The composition of the post-German territories and rest of Poland remained relatively stable in the subsequent decades, as mobility was limited under the centrally planned economy.

The newly acquired (post-German) territories were characterized by a relatively high level of infrastructure development (as measured by road density, water management facilities, and urbanization level) as compared to the remaining part of the country, especially the eastern regions. However, the expulsion of German nationals and the repopulation of the post-German territories with families from the far less developed east created a region with a largely uneducated population that lacked both human and social capital.

Regional differences in social cohesiveness appear to have been an important determinant of the extent of the economic and social dislocation following the onset of communist rule. On the one hand, the repopulation of the post-German area with migrants from the east lacking strong roots and institutions appears to have facilitated the imposition of the socialist economic paradigm, which placed the area at a disadvantage during the transformation. On the other hand, the central government was far less successful in collectivizing agriculture in the “traditionally Polish” and post-Austrian regions, where social networks and even some of the pre-war ownership structures (with respect to land and other real estate) were preserved. Although poorer and far more rural than the post-German region, the post-Austrian region consists of communities with deep social roots that largely escaped such profound dislocation post-World War II with the exception of some areas in the east. The city of Cracow (Krakow) forms the economic and cultural center of this region.

Perhaps the most damaging economic reforms were the establishment of large, state owned farms (PGRs) as the predominant economic form in rural areas of the post-German region. The PGRs were employing farmers as workers without granting them ownership of land. In many cases the PGRs were not only major employers but also institutions responsible for organizing local social life. The collapse of the state farms after the end of communist rules in Poland (they all went bankrupt in early 1990s) has driven the structural unemployment rate to 40% in some areas, leading to the material and social degradation of entire communities (Domańska, 2002; Gorzelak et al., 2006; Herbst, 2006). Similarly, the large proportion of the labor force employed in big state owned companies

¹ See Theil (1971) for a discussion of aggregation in linear models.

² Some Polish sociologists, economist, and geographers provide arguments and evidence that these divergent paths contribute to current regional differences in Poland. These include Bartkowski (2003), Gorzelak and Jałowicki (1997), and Działek (2009).



Fig. 1. Historical borders on today's Poland territories (left) and current administrative division (right). Areas under Russian rule prior to WW I are shaded black on the left map. Areas under Prussian (German) rule prior to WW I are shaded dark gray. Areas under Austrian (Austro-Hungarian) rule prior to WW I are shaded gray. Light gray areas on the left map represent German territories acquired by Poland after WW II. Source: Based on the administrative division of Poland according to the Central Statistical Office (GUS).

in the industrialized Wielkopolskie and Śląskie regions (see Fig. 1) in the mid-west also appears to have contributed to a particularly sharp increase in unemployment and a decrease in family income in these regions following the transition.

3.2. Regional variation in income and achievement

We now describe regional variation in per capita GDP and achievement. The left panel of Fig. 2 shows that income in eastern Poland remains generally well below income in the west, with the exception of Warsaw. Note that Eastern Poland generally relies much more heavily on the traditional agricultural sector, is far more conservative in voting preferences and has less developed infrastructure of any kind than the areas in the west.

By comparison, the right panel shows that average achievement in 2002 was highest in central and eastern Poland and lowest in the relatively affluent regions in the west and north. The absence of a strong, positive correlation between municipality average income and educational achievement contrasts the pattern observed in many but certainly not all countries. The pattern observed for Poland hints at the possibility that some factors favorable to high income such as a developed manufacturing sector may actually dampen educational attainment, possibly by reducing the expected return to schooling and incentive to acquire human capital.

4. Empirical framework

The inter-relationship among the various achievement determinants complicates an analysis of the contribution of historical events to inequality in academic achievement. Preferences, economic opportunities, social conditions, the quality and availability of public schools, and myriad other factors affect the choices of where to live and send children to school, and all of these factors are influenced by history. This interdependence introduces many pathways through which historical factors can influence academic outcomes, particularly in Poland where changes in geography, political, and economic institutions have had a profound effect on many aspects of life.

Our approach focuses on achievement differences among the four Polish historical regions and the degree to which specific family, school, economic, and social factors account for those differences. The four areas are frequently referred to in the Polish literature with historical names, such as Galicia, Congress Kingdom, Eastern Prussia etc. In this paper, for simplicity we will use the labels: post-Russian (for the territories under Russian rule before WW I), post-Prussian (for these under Prussian power in the same period), post-Austrian (for the territories controlled by Austria and then the Austro-Hungarian Empire before WW I), and post-German (for Poland's territorial gains after WW II).³ Although Warsaw (the capital of Poland) is located within the post-Russian area, we treat it as a separate region because of its far higher average income and average years of schooling and very different economic and social structures than the surrounding municipalities.

In order to identify the effects of specific factors on achievement the empirical model must control for variables that could potentially introduce bias. Given the limited information on schools, families, and communities, the available variables almost certainly do not account for all confounding factors. Fortunately, the multiple years of test score data facilitate the use of models that control for unobserved differences among municipalities that are constant over time. We will use these fixed effect models to estimate the effects of specific variables and to describe residual average achievement differences among regions not explained by the included variables.

One limitation of fixed effects models is that variables whose values do not change over time cannot be included in the model. In this context historical information cannot be included directly, and we must investigate the relationship between achievement and historical factors using a different approach. Our approach is to look at the average values of the municipality fixed effects in the historic regions to see whether the regional differences in achievements remain significant after we control for the family, school, and community related factors. Then we discuss the residual differences in

³ As one can see on Fig. 1 the historical borders do not fully overlap with the current administrative division of Poland.

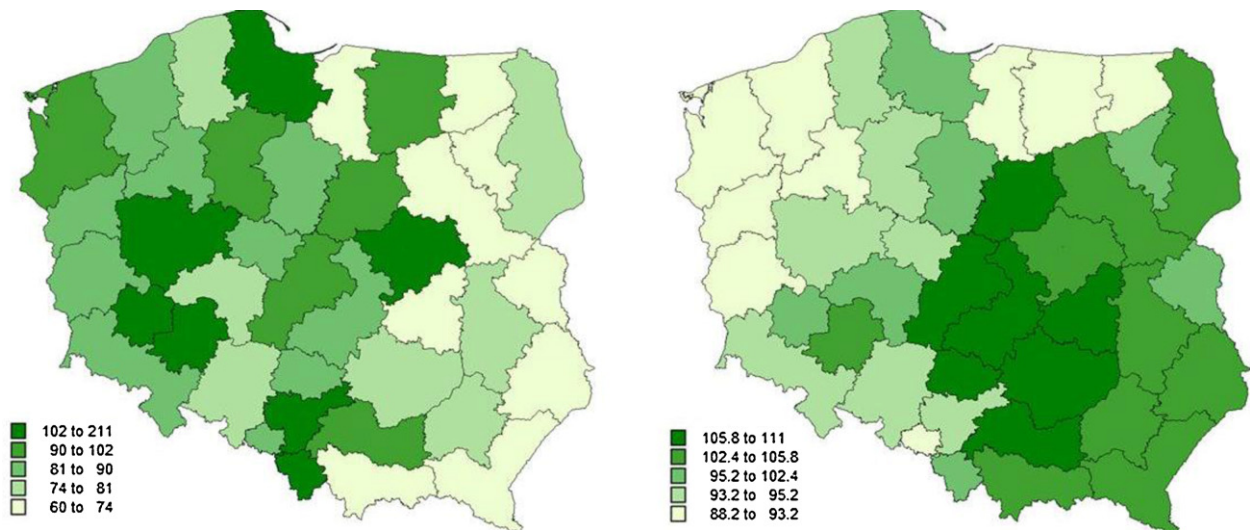


Fig. 2. 2003 GDP per capita (left) and the 2002 average score in the 9th grade math–science test (right) by subregions. Poland = 100. Source: Based on data from the Central Statistical Office (GUS) and Central Examination Committee (CKE).

the context of the diversity of historical experience, as expressed by the regional averages of the history related variables.

4.1. Regression specifications

In this section we describe the models used in the empirical analysis. Because we do not have access to student level data and are unable to follow students as they age, we develop the model at the municipality–year level of aggregation. Note that some municipalities consist of a single or small number of schools, and others include many schools. In addition, information on some variables is provided only at the more aggregate county level, and we account for both enrollment differences and aggregation to the county level in the estimation.

Eq. (1) highlights key issues that must be addressed in order to generate consistent estimates of the causal effects of characteristics on achievement. Here average achievement A for students in municipality s in year y is a function of average family (X), school (S), economic (E), and social (M) characteristics:

$$A_{sy} = \beta X_{sy} + \delta S_{sy} + \lambda E_{sy} + \gamma M_{sy} + \theta_s + e_{sy} \quad (1)$$

Family background is measured by the distribution of parental education into four categories, schools are characterized by teacher qualifications and spending per-pupil, economic activity is measured by the local unemployment rate, and the social environment is measured by proportion of the municipal population living in rural areas, the share of the elderly population living in the same municipality in which they were born, and the average inflow of the population to the municipality in the previous eight years (see the next section for descriptive characteristics). The error has two components, θ and e . θ is a municipality fixed effect that captures unobserved factors at the municipality level that do not vary between 2002 and 2008. These can include aspects of family background, infrastructure, industry composition, schools (including building quality), and other determinants of achievement. Finally, e is assumed to be a random error that varies by municipality and time.

If the included variables were uncorrelated with θ and e , OLS would yield unbiased estimates of the parameters. But given the non-random sorting of students and teachers into schools and communities and the plethora of omitted determinants of achievement, it is highly unlikely that the limited number of controls would account for all potential confounding factors.

Our basic approach is to use the availability of two observations per municipality to control for observed and unobserved differences among municipalities in student, family, school, and community factors by including municipality fixed effects. First differences is equivalent to fixed effects in the case of two time periods, and Eq. (2) writes the difference in achievement between 2008 and 2002 as a function of the difference in the variables and the errors:

$$\begin{aligned} (A_{s2008} - A_{s2002}) = & \beta(X_{s2008} - X_{s2002}) + \delta(S_{s2008} - S_{s2002}) \\ & + \lambda(E_{s2008} - E_{s2002}) + \gamma(M_{s2008} - M_{s2002}) + (\theta_s - \theta_s) \\ & + (e_{s2008} - e_{s2002}) \end{aligned} \quad (2)$$

Taking first differences eliminates the time invariant error component, effectively accounting for all fixed differences among municipalities. Consequently time-invariant unobserved determinants of achievement do not introduce bias in the first-differences model. Only variables that change over time can contaminate the estimates, and a key identifying assumption is that the included variables are orthogonal to any such factors. This assumption cannot be tested, but we discuss its plausibility and potential violations to it in the next section.

5. Results

This section begins with a description of regional differences in average student achievement and its potential determinants and then turns to the regression results. We are interested in both the extent to which specific characteristics account for regional variation in achievement and the implications for education policy. Consequently we discuss both the magnitudes of the individual estimates and the overall variable contributions to region differences.

5.1. Regional differences

The top panel of Table 1 shows sizeable regional differences in student achievement. Measured as the average for both years, the mean test score in math–science in the post-German and post-Prussian territories lies far lower than the mean in the post-Austrian and post Russian regions; the difference is roughly three fourths of a standard deviation. The regional differences do decline

Table 1
Descriptive statistics by historical regions of Poland. Population weighted means calculated on Pooled 2002 and 2008 data (standard deviations in parentheses).

Variable	Post-Austrian region	Post-Prussian region	Post-German acquired 1945	Post-Russian region (w/o Warsaw)	Warsaw
School achievements					
Standardized 9th grade test score in math–science pooled	0.38 (0.93)	−0.37 (0.72)	−0.42 (0.91)	0.185 (1.03)	1.26 (0.53)
Standardized 9th grade test score in math–science (2002) ^a	0.46 (0.93)	−0.51 (0.68)	−0.47 (0.87)	0.34 (1.05)	0.66 –
Standardized 9th grade test score in math–science (2008) ^a	0.29 (0.84)	−0.21 (0.81)	−0.37 (0.99)	−0.00 (0.86)	2.08 –
Family variables					
% of population 35–50 years old by educational attainment					
Higher or general secondary	19.0 (9.1)	18.6 (7.8)	19.6 (8.4)	18.7 (7.4)	40.8 (6.3)
Vocational secondary	30.8 (3.7)	28.5 (3.8)	30.2 (3.7)	31.6 (4.8)	36.6 (0.9)
Basic vocational	38.1 (8.7)	40.0 (7.5)	34.7 (7.3)	34.5 (7.0)	13.5 (0.3)
Primary	12.1 (4.8)	12.9 (5.0)	15.5 (6.2)	15.2 (6.1)	9.1 (6.8)
School variables					
Per student spending on lower secondary schools (log)	8.41 (0.39)	8.42 (0.39)	8.44 (0.41)	8.43 (0.40)	9.01 (0.61)
% of teachers by the level of qualifications					
2nd level	20.7 (9.9)	19.8 (7.8)	19.8 (8.1)	19.4 (9.1)	21.6 (4.9)
3rd level	44.5 (17.1)	52.1 (14.8)	51.6 (15.5)	50.8 (17.8)	51.8 (11.4)
4th level	27.7 (21.3)	20.9 (18.0)	21.1 (18.3)	23.0 (20.4)	19.6 (19.4)
Economic characteristics					
Unemployment rate	12.4 (5.1)	12.8 (7.9)	17.8 (9.7)	10.5 (5.2)	3.8 (2.7)
Social characteristics					
Municipality share of recent arrival (yearly average over eight years in %)	1.0 (0.3)	1.2 (0.6)	1.2 (0.5)	1.1 (0.6)	1.0 (0.0)
Rural population share in municipalities	51.7 (44.9)	32.3 (40.3)	33.0 (39.8)	46.8 (45.5)	0.0 (0.0)
Locally born share among population 60 years old or above	52.7 (20.6)	36.7 (12.4)	7.2 (11.7)	46.4 (18.4)	32.6 –

^a When reported separately, scores for 2002 and 2008 are also separately standardized, so that each year of data has a mean of zero and a standard deviation of one.

between 2002 and 2008, particular the gap between the post-German and post-Russian regions.

Note, however, that the regional convergence in test scores has not remained constant throughout the time period. Fig. 3 shows that the regional differences fell between 2002 and 2006 (the year that the differences were smallest in most cases) and tended to increase slightly and stabilize in the subsequent years. Therefore it does not appear that these differentials are likely to disappear over the next few years.

One gap that has actually increased substantially over time is the differential between Warsaw and the other regions. As shown in Fig. 3, achievement in Warsaw increased every year between 2002 and 2008. By the end of the period average achievement in Warsaw exceeded the national average by roughly two standard deviations.

The extent to which the observed characteristics account for achievement differences both among regions and over time is one of the main questions explored in the regression analysis. In order for a variable to account for a substantial portion of one of these differentials it must be significantly related to achievement and vary substantially by place or time. We now summarize the distributions of these characteristics by region.

Ignoring Warsaw for the moment, the bottom panel of Table 1 reveals generally small regional differences in the explanatory variables and a lack of systematic ordering by region. Consider first parental education, approximated by school attainment distribution of those 35–50 years old. The share of population aged 35–50

with higher or general secondary education attainment is between 18.6% in the post-Prussian region and 19.6% in the post-German region (the region with the lowest average test scores). Fig. 4 does reveal substantial variation in the share of residents with the highest educational attainment level within regions, largely reflecting differences between rural and metropolitan areas. Most of the darkest areas on the maps (the areas with the highest shares) are large metropolitan areas including Warsaw, Cracow, Poznan, Wroclaw and Gdansk.

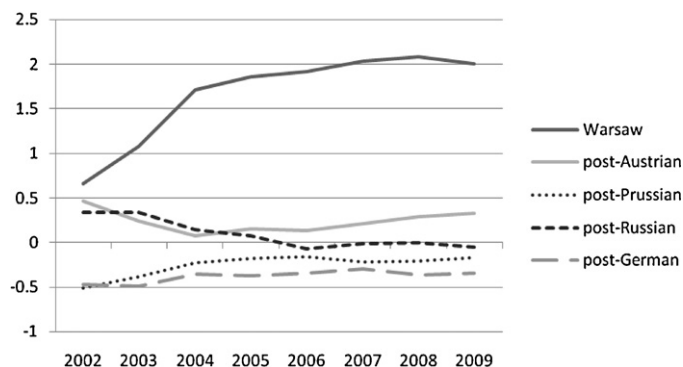


Fig. 3. Standardized test scores by region, 2002–2009. Source: Based on data from the Central Examination Committee.

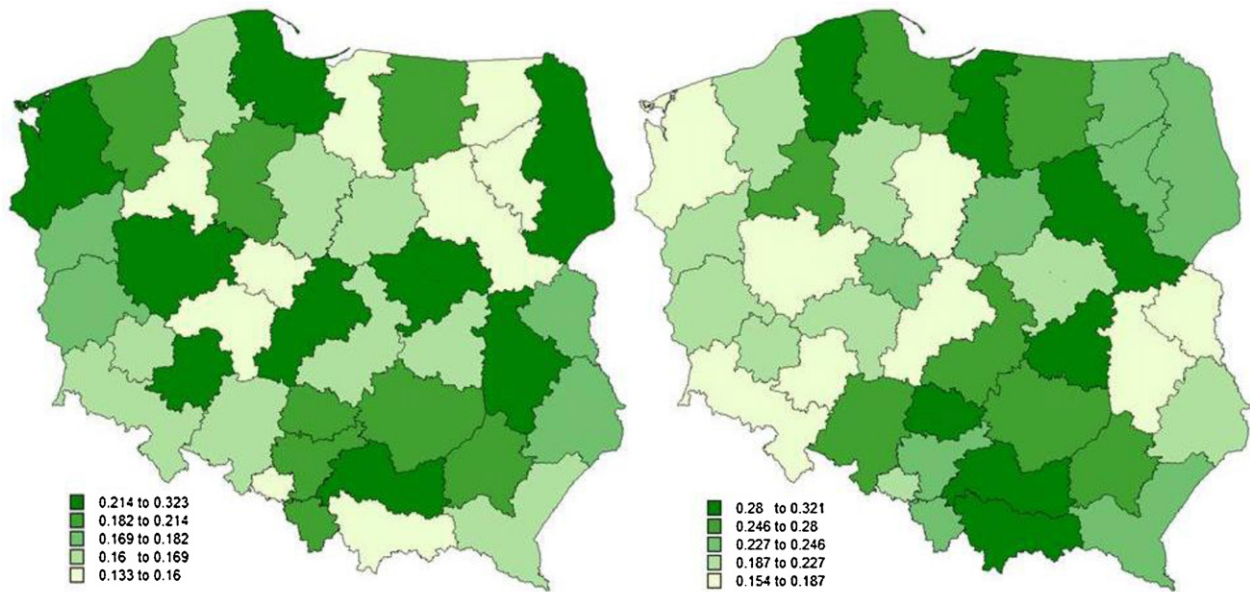


Fig. 4. The share of the population 35–50 years old holding higher or general secondary education (left) and the share of lower secondary school teachers holding the highest (4th) level of formal qualifications (right). Averaged 2002 and 2008 data. Source: Based on data from the Central Statistical Office (GUS) and System of Information on Education (SIO).

The distribution of the population share with only a primary education produces a slightly different pattern, though again the region differences are small and not strongly ordered by region average achievement. Although the low scoring, post-German region has the highest share (15.5%), the difference between the post-German and high-scoring post-Russian region is only 0.3 percentage points.

In terms of the school characteristics, the patterns are mixed in terms of the potential to account for regional achievement differences. On the one hand, differences in per student spending on lower secondary schooling are not strongly related to achievement in the expected direction. Rather average spending is lowest in the highest-scoring historical region (post-Austrian) and highest in the low-scoring post-German region, with the differences between the four regional averages not exceeding 3%. On the other hand, differences in the share of teachers who are highly qualified (4th level of professional status) correspond to differences in achievement. Fig. 4 illustrates that municipalities across the higher scoring post-Austrian and post-Russian regions tend to have higher proportions of highly qualified teachers.

The unemployment rate variable also indicates that differences in economic activity following the transformation could contribute to achievement differences. The average unemployment rate of 17.8% in the low-scoring, post-German region indicates that this area experienced deeper transition problems than the other regions. Remaining regional differences are small, ranging between 10.5% and 12.8%.

Finally, the variables describing population movements and community type exhibit little variation in one case and substantial variation in the other two variables. On the one hand, the share of population that arrived in the past eight years ranges from 1.0 to 1.2%, indicating that recent population movements are unlikely to account for much of the achievement differential. On the other hand, there are meaningful differences in the proportion of the population living in rural areas and in the share of the elderly living in the municipality where they were born. Interestingly, the share of the population living in rural areas appears to be positively related to achievement, as the two regions with highest average achievement have the two highest rural shares. As

many as 52% of residents in the post-Austrian territory live in rural settlements, while the corresponding figure for the post-German and post-Prussian regions is one third. Not surprisingly, the share of elderly born in their municipality is much lower for the post-German region acquired by Poland after World War II (7.2%); the values for the other regions range from 36.7% in the post-Prussian to 52.7% in the post-Russian region.

5.2. Regression results

In order to understand the contribution of specific factors to regional achievement differences we estimate two regression specifications. The first uses both cross-sectional and time series variation, while the second includes municipality fixed effects and therefore uses only within metropolitan area variation over time. Because unobserved factors that differ across municipalities almost certainly bias the estimates from the first specification, we believe that the fixed effect specifications produce more compelling estimates. Nonetheless, the fixed effect specifications remain susceptible to confounding factors that vary over time, and we discuss this issue below. Note that both regressions are weighted by the municipality population and that *t*-statistics and *p*-values are reported in the tables.

A comparison of the estimates in Columns 1 and 2 of Table 2 shows that the inclusion of the municipality fixed effects tends to increase the magnitude and significance of the estimates. This suggests that unobserved differences among municipalities likely bias downward the estimates of most school and family background effects. The one exception is rural share, and it is not surprising that the fixed effect estimates are small and insignificant given the generally small changes in rural share during the period in question. Cross-sectional differences in rural share are almost certainly correlated with a number of factors.

In terms of the specific factors, the share of parents with at least a secondary level academic education is positively related to achievement, consistent with the virtually universal finding that higher parental education raises achievement. Surprisingly, the share that has completed a secondary vocational degree is negatively related to achievement. This suggests that a strong vocational orientation

Table 2
Weighted least squares and fixed effect coefficients from achievement regressions (standard errors in parentheses).

Column Estimation method	1		2		3	
	Weighted least squares		Fixed effects		Fixed effects	
	Coefficients	p-value	Coefficients	p-value	Coefficients	p-value
Regional dummy variables						
Post-Prussian	–3.689 (0.563)	0.000				
Post-Austrian	–2.885 (0.563)	0.000				
Post-Russian (w/o Warsaw)	–2.971 (0.557)	0.000				
Warsaw	–2.989 (0.569)	0.000				
Post- German	–3.573 (0.559)	0.000				
Family variables						
Parental education –higher	5.282 (0.429)	0.000	15.144 (1.358)	0.000	13.742 (1.358)	0.000
Parental education –secondary vocational	–0.600 (0.391)	0.125	–3.609 (1.902)	0.045	–3.534 (1.822)	0.053
Parental education – basic vocational	1.741 (0.449)	0.000	2.075 (1.415)	0.143	2.032	0.156
School variables						
Log spending per student	0.093 (0.047)	0.050	0.212 (0.073)	0.004	0.271 (0.073)	0.000
Teacher qualifications – 2nd level	0.576 (0.277)	0.038	1.075 (0.372)	0.004	1.231 (0.375)	0.001
Teacher qualifications – 3rd level	1.022 (0.249)	0.000	1.564 (0.342)	0.000	1.707 (0.344)	0.000
Teacher qualifications – 4th level	1.127 (0.259)	0.000	1.058 (0.372)	0.005	1.102 (0.376)	0.000
Economic characteristics						
Unemployment rate	–2.047 (0.242)	0.000	–3.780 (0.536)	0.000		
Social characteristics						
Population inflow	5.183 (2.460)	0.035	25.609 (7.562)	0.001	26.331 (7.647)	0.001
Rural population	–0.164 (0.037)	0.000	0.323 (1.176)	0.784	0.531 (1.189)	0.655
N	4594	4594	4594			

may not be conducive to academic achievement, though it also raises the possibility of omitted variables bias since it is surprising that additional parental schooling, even with a vocational emphasis, would reduce achievement.

The coefficients on school spending and teacher qualifications support the belief that higher spending and more qualified teachers raise achievement. All are positive and significant at the 0.01 significance level in the fixed effects specification. The one anomaly is the larger coefficient on share with 3rd level as opposed to 4th level qualifications; the magnitude of the coefficient on share with 4th level qualifications is quite similar to that of the share with 2nd level qualifications.

Two phenomena likely contribute to the non-monotonic relationship between teacher credential level and student performance. The first is that changes in the distribution of teacher certification levels come from both changes in the stock of teachers and the acquisition of higher level credentials by current teachers. If these credentials serve as signals of quality, acquisition of a higher level credential by a teacher already in the municipality should have little or no effect on the quality of

instruction. As it takes longer to achieve the highest level credential, a larger share of teachers in the 4th level category in 2008 were teaching in the municipality in 2002 albeit with a lower level credential in many cases. Therefore the changes over time in the share of teachers with the highest level credential provides a noisy measure of the change in teacher quality associated with hiring teachers able to achieve that credential.

The second phenomena concerns teacher cohort differences in quality that would also tend to attenuate the coefficients for the higher levels of certification. Improvements in pay and working conditions beginning in the late 1990s made teaching a more attractive profession in Poland and likely increased the quality of new entrants. As the highest certification levels have minimum experience requirements that preclude new teachers from attaining those levels regardless of their skills, any negative relationship between experience and teacher quality would tend to introduce negative bias into the estimates of the highest level certification coefficients in the absence of experience controls.

Table 3

Weighted least squares and fixed effect coefficients for specifications that differ by included variables (standard errors in parentheses).

Column	1		2		3		4		5		6	
Estimation method	Weighted least squares				Fixed effects							
	Coefficients	p-value	Coefficients	p-value	Coefficients	p-value	Coefficients	p-value	Coefficients	p-value	Coefficients	p-value
Family variables												
Parental education – higher	5.282 (0.429)	0.000	7.008 (0.371)	0.000			15.144 (1.358)	0.000	13.974 (1.292)	0.000		
Parental education – secondary vocational	–0.600 (0.391)	0.125	–0.265 (0.382)	0.489			–3.609 (1.902)	0.045	–3.098 (1.751)	0.077		
Parental education – basic vocational	1.741 (0.449)	0.000	2.87 (0.422)	0.000			2.075 (1.415)	0.143	1.313 (1.388)	0.344		
School variables												
Log spending per student	0.093 (0.047)	0.050			0.223 (0.048)	0.000	0.212 (0.073)	0.004			0.412 (0.073)	0.000
Teacher qualifications – 2nd level	0.576 (0.277)	0.038			0.503 (0.287)	0.079	0.503 (0.372)	0.004			0.773 (0.383)	0.044
Teacher qualifications – 3rd level	1.022 (0.249)	0.000			0.858 (0.258)	0.001	1.564 (0.342)	0.000			1.601 (0.353)	0.000
Teacher qualifications – 4th level	1.127 (0.259)	0.000			0.871 (0.268)	0.001	1.058 (0.372)	0.005			0.743 (0.384)	0.053
Economic characteristics												
Unemployment rate	–2.047 (0.242)	0.000			–4.134 (0.215)	0.000	–3.780 (0.536)	0.000			–2.648 (0.547)	0.000

The unemployment rate and share of population new to the area coefficients are also highly significant. In the case of the unemployment rate, the negative estimate indicates that economic problems adversely affect academic achievement. Whether the underlying mechanism is a lack of family resources or poor family environment caused by job loss is not clear. In the case of population movement, the positive and significant estimate suggests that a higher share of new entrants is associated with higher rather than lower achievement. This indicates that any disruption caused by migration is offset by other factors which could include population movement to areas with better schools or economic opportunities or a stronger commitment to academic success on the part of movers. The positive effect of immigration on school achievement in both cross-section and panel analysis may also reflect the growing process of suburbanization in Poland in which relatively affluent and highly educated urban residents move to the outer rings of the cities.

The fixed effect estimates find a strong relationship between achievement on the one hand and the local unemployment rate, parental education, and teacher characteristics on the other, but it remains possible that other confounding factors influence the estimates of the effects of these variables. A sensitivity analysis (reported in the Table 3), supports the notion that if anything the magnitudes of the effects are larger than those in Table 2, as the exclusion of explanatory variables tends to increase rather than decrease the magnitudes of the estimates. We turn now to an examination of the regional differences in residual achievement in order to learn more about the likely contributions of historical events to current inequality achievement.

5.3. Regional differences

We now examine the pattern of regional achievement differences in order to gain a better understanding of the potential importance of the included characteristics in explaining the observed variation. Table 4 describes region differences in mean achievement levels, where the first column reports unadjusted region means, the second column reports the region coefficients from the regression without municipality fixed effects, and the third column reports region average municipality fixed effects obtained from the fixed effect regressions. A comparison of the differences in unadjusted means with the differences in region

average fixed effects shows the extent to which region differences in the included factors account for the raw region differences. Note that the residual differences could actually exceed the raw differences in some cases if differences in the included characteristics actually offset differences due to unobserved factors.

In fact a comparison of Columns 1 and 3 shows that controlling for the characteristics reduces region differences in most but not all cases. The included variables more than fully account for raw achievement differences in one case (post-Prussian vs. post-German), fully account for differences in one case (post-Austrian vs. post-Russian), partially account for the gap between the post-Austrian and post-German regions, inflate the gap between the post-Russian and post-Prussian area, and have little or no effect on the remaining differences (post-Austrian vs. post-Prussian and post-Russian vs. post-German).

The region differences in characteristics reported in Table 1 and regression results reported in Table 2 point to the unemployment rate but not to the school characteristics as important determinants of regional achievement differences. Based on both sizeable regional differences and an economically and statistically significant coefficient, the more difficult economic climate as measured by a higher unemployment rate appears to be a primary cause of lower achievement in the post-German region. This appears to provide a link between the post-WWII communist economic policies including the collectivization of agriculture and low academic achievement in subsequent generations.

Although the coefficients on school spending and teacher qualifications are also significant, the region differences are small. In all four regions roughly 7% of teachers lack any qualification beyond the first level. Thus although school quality may contribute to

Table 4
Historical region raw and regression adjusted achievement differences.

Column Region	1 Mean weighted test scores	2 WLS coefficients	3 Mean fixed effects
Post-Austrian	0.381	–2.885	0.414
Post-Prussian	–0.369	–3.689	–0.392
Post-German	–0.417	–3.573	–0.216
Post-Russian	0.185	–2.971	0.413
Warsaw	1.263	–2.989	–1.584

region differences in achievement, the included characteristics do not capture any such effects.

5.4. Historical factors and remaining regional differences

The substantial explanatory power of the local unemployment rate in explaining the regional gap supports the hypothesis that communist economic policies had deleterious effects on subsequent generations, but this and the other variables do not account for the bulk of the regional achievement differentials. Because of the difficulty accounting for the many factors that differ by region and potentially affect achievement, efforts to explain the residual variation with cross-sectional regressions are unlikely to produce compelling results. Therefore we take a less ambitious path and compare residual achievement differences with a small number of factors in an effort to learn whether differences in particular factors are consistent with their contributing to the observed achievement differences. We are particularly interested in factors potentially related to social capital and those related to the manufacturing share of the regional economy.

The concept of social capital deserves special attention in the context of explaining educational achievements. Developed in the classical works of Bourdieu (1986), Coleman (1988), and Putnam (1993) the term social capital refers to common characteristics of groups of people, such as beliefs, social norms, or confidence toward others, which exert influence on the achievements of group members in many areas of their life. There exists strong international evidence that school and community levels of social capital influence education outcomes via effects on school management, cooperation between parents and school, student motivation, peer interactions, and out-of-school learning. Coleman et al. (1966) shows for example, that peer group influence on student achievement may be stronger than the effects of school resources.

More recently, Israel and Beaulieu (2004) explore the influence of social capital on 8th grade test scores and gains from 8th to 12th grade for math and reading. They conclude that a number of measures of social capital in the school and community have a significant effect on achievements, independent of individual characteristics and school resources. Andersson and Subramanian (2006) also find that neighborhood characteristics related to socioeconomic resources and demographic stability are significant predictors of individual educational outcomes in Sweden, as measured for three different cohorts in 2000. A strong association between neighborhood socio-cultural capital variables and education is also observed.

Finally, Gordon and Monastiriotis (2007) examine potential non-linearities of the relationship between population and pupil attributes on the one hand and the outcomes on the other as a way to isolate the contribution of neighborhood and peer effects. The results reveal the existence of non-linear relationships between the class/ethnic composition of local populations, school absence and SEN rates, and school intake quality. This supports the presence of significant neighborhood and peer influences.

Turning back to our analysis, Table 5 illustrates region differences in achievement, the average fixed effects, and six variables that describe the character of local labor markets, the degree of historical continuity in socio-economic relations over the twentieth century, and the level of civic engagement by local populations. They are the share of workers employed in manufacturing in 2008, the share of total agriculture area under production that was collectively operated in 1992 (just following the transition), the share of elderly (aged over 60) that were born in the same municipality as they currently reside, the share of elderly born abroad, the turnover in local elections of 2006, and the number of registered non-governmental organizations (foundations, associations, voluntary fire brigades or sport clubs) as of 2008.

The associations among variables provide suggestive evidence that both a lack of social capital (absence of longstanding educational and social institutions) and the structure of the local economy contribute to the current achievement differences. Columns 3 and 4 in Table 5 show that the elderly living in the post-German region were far less likely to have been born in their current municipality (fewer than half) and far more likely to have been born abroad (mostly in territory ceded to the Soviet Union) than the elderly living in the other regions. Only 7% of elderly in the post-German region were born in the same municipality as compared to 37% in the post-Prussian region and at least 46% in the other regions. Moreover, more than 16% of the elderly now living in the post-German region were born abroad; the corresponding values for the remaining three historical regions range from 3.1% to 4.5%.

Thus municipalities in the post-German region experienced far more in-migration than municipalities in the other regions, and the migrants to the post-German region experienced more profound changes in terms of both physical and cultural distance. The magnitude of these changes almost certainly hindered the development of social institutions supportive of academic achievement in the post-German region, offsetting some of the advantages resulting from the region's higher per-capita income. The higher in-migration in the post-Prussian region in comparison to the other two may well have hindered the development of social institutions and contributed to lower achievement levels in that region as well.

The hypothesis of a social capital deficit in western and northern Poland also receives somewhat weak support from recent data on local election participation. Column 6 in Table 5 shows that the turnover in local elections is higher in the post-Austrian and post-Russian regions (even excluding Warsaw from the latter) than in the post-Prussian and post-German area, though the differences are small. Nonetheless, these differences are in line with the gaps in average school achievement. On the other hand, another variable related to civic engagement—the number of NGOs per capita, is relatively high in the regions with low average test scores (see column 5 in Table 5). It should be noted however that the development of registered, organized forms of social activity tends to be higher in urban areas in which there are often weaker relationships among community members and higher levels of alienation in comparison to rural areas, where common activities may be performed without legal forms. This may explain why the NGO density is higher in the post-German and post-Prussian territories, where two thirds of the population lives in the cities, as compared to the post-Russian and post-Austrian regions, where the share of urban population is 53 and 48% respectively (see Table 1).

Of course these simple comparisons are far from definitive and they certainly do not explain the very low test scores and residuals in the post-Prussian region. An examination of Table 4 reveals that the two low-scoring regions also had a higher share of agricultural land that was collectivized as of 1992 and a higher share of workers in the manufacturing sector in 2008, each of which could have exerted deleterious effects on academic performance. Column 7 of Table 4 shows the average shares of collectively operated agricultural areas in 1992 (beginning of the transformation period) are 5–6% in the post-Russian and post-Austrian territories but 13.5% and 20.6% respectively for the post-Prussian and post-German regions. Column 8 shows that the manufacturing share of employment was 34% in the post-German region, 37% in the post-Prussian region, 30% in the post-Austrian region and only one quarter in the post-Russian region. These higher rates of collectivization are likely explained in part by the post-war population relocation and consequent discontinuity of ownership and the related lack of strong social institutions in the post-German region and the unacceptable (to the communists) dominance of large private land-owners in the post-Prussian region prior to WWII.

Table 5
Means of history and social capital related variables by historical region.

Column	1 Standardized test score	2 Mean fixed effect	3 Share of elderly born in the same municipality (2002)	4 Share of elderly born abroad (2002)	5 NGO per 10,000 of population (2008)	6 Turnover in local municipal elections (2006)	7 Share of area under collective agricultural use (1992)	8 Share of employed in manufacturing (2008)
Post-Austrian	0.381	0.414	52.7	3.5	34.0	46.9	6.3	30.0
Post-Prussian	-0.369	-0.392	36.7	4.5	30.5	44.1	13.5	37.3
Post-German	-0.417	-0.216	7.2	16.7	34.4	43.8	20.6	33.6
Post-Russian w/o Warsaw	0.185	0.413	46.4	2.8	28.6	47.5	5.0	25.5
Warsaw	1.263	-1.584	32.6	5.1	60.9	52.9	6.4	16.1

The higher rates of collectivization almost certainly made the post-German and post-Prussian regions more vulnerable to the transformation shock of the 1990s, as state owned companies, both in manufacturing and agriculture, proved largely unable to compete on the free market. Although the much higher unemployment rate in the post-German region during the 2000s captures a portion of the economic dislocation experienced by those in communities with a high degree of collectivized agriculture, it is certainly possible that it failed to capture all of the lingering effects of that economic structure on current day social and economic conditions.

The higher share of manufacturing employment in the post-German and post-Prussian areas is also consistent with another channel through which the economic structure could affect achievement: the expected return to investment in education. If a greater likelihood of working in manufacturing weakens the demand for schooling and in turn the demand for higher school quality, achievement is likely to be lower. The fact that the share of teachers with highest level qualifications is far higher in the post-Austrian than in the post-German or post-Prussian regions provides some support for this hypothesis, though the regression estimates do not find that having a highest level qualification raises teacher quality relative to someone with a third level of qualification.

Unfortunately, Polish data limit the possibilities for analyzing directly regional variation in the returns to various types of schooling. However, household survey data can be used at the geographic level of the 16 administrative provinces to produce ratios of the average earnings of those with a higher education to those with a vocational secondary education. Fig. 5 illustrates this earnings ratio for the 16 administrative provinces and shows that indeed the returns to higher education in western Poland appear to be lower than in the East. Because college graduate wages are lower in the east than in the west, if students used average earnings of college graduates at the national level in forming expectations the regional differential in the expected rate of return (to education combined with migration) would be even larger. In fact, other research shows that the ability of cities in eastern Poland to retain local university graduates is substantially weaker than in the case of western metropolises (Herbst, 2010).

In summary, the patterns observed in Table 5 are certainly consistent with the view that extensive population relocation and communist economic policies exerted long-term adverse affects on academic achievement, particularly in the post-German and to a lesser extent in the post-Prussian territories. These patterns also suggest that the high living standards produced by the advanced manufacturing sector in the post-Prussian region may even have had a negative influence on achievement by reducing the incentives for families to invest in education and communities to invest in school quality. Yet much more work needs to be done to identify the actual effects on social structures, family choices, and current economic activity prior to drawing firm conclusions on the longer-term contributions of these historical factors to academic achievement.

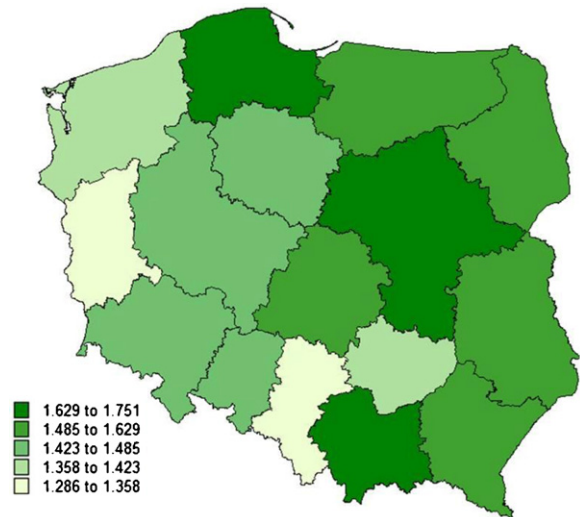


Fig. 5. Regional returns to higher education as compared to vocational secondary education in 2008. (Per capita household income for individuals holding higher education degree versus vocational secondary education.). Source: Based on data from the Household Budget Survey, Central Statistical Office 2008.

6. Conclusions

Regional differences in historical circumstances and academic achievement suggest the possibility that the divergent histories of the various Polish regions contribute to current inequality in academic achievement through their effects on social and economic structures, school quality, and family resources. Of course history involves a series of interrelated events, complicating efforts to isolate the importance of any one. Therefore we take an indirect path in our efforts to understand better the effects of any single event or set of circumstances. First we investigate the effects of a set of family, school, economic and social factors measured during the 2000s on academic achievement and describe their variation among regions. Second, we compute residual regional differences in achievement that remain once we account for the influences of these variables. Finally, we compare the patterns of these residual differences with differences in social and economic factors such as the collectivization of agriculture and population relocations that are directly related to historical events. These comparisons along with the findings on the specific variables in the regression analysis that can be linked with historical events (such as the regional rate of unemployment) provide a rich set of information with which to consider the past and current determinants of academic achievement. Our approach does not provide definitive answers to the role of specific factors, but it does provide a richer fabric of information with which to consider both the legacy of particular historical events and arrangements and appropriate

policies to address deficits in educational achievement in particular locales.

The results find some support for the belief that longer term differences in industrial development contribute to current regional achievement differences and stronger support for the belief that events following WWII including massive population relocation and collectivization of both agricultural and non-agricultural production had particularly adverse effects on the post-German region. The regression estimates also indicate that standard measures of school quality including teacher qualifications and spending are significantly related to achievement in the expected direction.

In terms of policy, the findings on the school and teacher variables indicate that improvements to the quality of schooling as measured by teacher qualifications and spending translate into higher achievement in Poland. It should be noted that this finding is not always replicated in other studies, highlighting the importance of delving deeper into the determinants of Polish school quality. Moreover, other reforms may provide more cost effective mechanisms for raising the quality of education. Nonetheless, the results confirm the importance of school quality as a lever with which to improve academic outcomes in Poland.

The strong negative effect of local unemployment and patterns of relationships between achievement on the one hand and population movements and agricultural collectivization on the other present less clear policy prescriptions. More in-depth investigation, perhaps through descriptive and ethnographic research, might paint a clearer picture of the channels through which high unemployment, a high rate of agricultural collectivization, and extensive population mobility affect achievement; such knowledge could enable the development of sharper and more targeted policies. The evidence certainly suggests the desirability of targeted efforts to increase aggregate demand and bolster social and educational institutions that support academic attainment, but these are blunt and potentially not very effective means of improving academic and related social and economic outcomes.

Finally, those living in areas such as the post-Prussian region with historically advanced manufacturing economies may have weaker incentives to invest in education, and the communities may not place a high priority on raising school quality. If students in these locales have opportunities to earn good wages in manufacturing for the foreseeable future the lower investment in education would appear to be an appropriate response. However, given the global economic changes including the increase in the return to schooling, such choices may be myopic and harmful to these students and communities in the long run, justifying policy interventions.

References

- Andersson, E., Subramanian, S.V., 2006. Explorations of neighbourhood and educational outcomes for young Swedes. *Urban Studies (Routledge)* 43 (11), 2013–2025.
- Bartkowski, J., 2003. *Tradycja i polityka*. Żak Wydawnictwo Akademickie, Warszawa.
- Bourdieu, P., 1986. The forms of capital. In: *Handbook for Theory and Research for the Sociology of Education*. J.G. Richardson, New York, Greenwood, pp.241–258.
- Bratti, M., Checchi, D., et al., (2007). Territorial differences in Italian students' mathematical competencies: evidence from PISA 2003. IZA Discussion Paper, Institute for the Study of Labor. 2603.
- Coleman, J., 1988. Social capital in the creation of human capital. *American Journal of Sociology* 94, 95–121.
- Coleman, J., Armor, D., et al., 1966. *Equality of educational opportunity*, US Government Printing Office.
- Czapiewski, K.L., Śleszyński, P., 2007. Geografia zróżnicowania wyników egzaminów zewnętrznych. Egzamin. *Biuletyn Badawczy Centralnej Komisji Egzaminacyjnej* (11), 52–79.
- Daniele, V., Malanima, P., 2011. Are people in the south less intelligent than in the north? IQ and the north–south disparity in Italy. *Journal of Socio-Economics* 40, 844–952.
- Domańska, L., 2002. Deprywacja potrzeb byłych pracowników państwowych przedsiębiorstw gospodarki rolnej. Toruń, Uniwersytet Mikołaja Kopernika.
- Działek, J. (2009). Social capital and economic growth in Polish regions, MPRA Paper No. 18287.
- Dzięcioł-Kurczoba, B., 2008. Przestrzenne zróżnicowanie wyników egzaminu gimnazjalnego i matury z geografii w Polsce. In: Wiśniewski, R., Gierańczyk, W. (Eds.), *Geografia we współczesnym systemie kształcenia*, vol. 38. IGiPZ PAN, Warszawa, pp.54–60.
- Gawryśki, A., 2005. *Ludność Polski w XX wieku*. IGiPZ PAN, Warszawa.
- Gordon, I., Monastiriotti, V., 2007. Education, location education: a spatial analysis of english secondary school public examination results. *Urban Studies* 44 (7), 1203–1228.
- Gorzela, G., Jałowicki, B. (Eds.), 1997. *Koniunktura gospodarcza i mobilizacja społeczna w gminach*, EUROREG. Uniwersytet Warszawski, Warszawa.
- Gorzela, G., Herbst, M., et al., 2006. Jak poprawić sytuację na trudnym rynku pracy? *Studia Regionalne i Lokalne* 23 (1), 37–63.
- Haahr, J.H., 2005. Explaining student performance. Evidence from the international PISA, TIMSS, and PIRLS Surveys, Danish Technological Institute.
- Hanushek, E. A., Woessmann, L., 2007. The role of school improvement in economic development. Program on Education Policy and Governance, research paper 07–01.
- Herbst, M., 2006. Human capital formation in Poland. Where does educational quality come from? *Studia Regionalne i Lokalne (special issue)*, 113–128.
- Herbst, M., 2008. Prognoza wzrostu gospodarczego polskich regionów do 2015 roku. *Studia Regionalne i Lokalne* 32 (2), 61–71.
- Herbst, M., 2010. Creation and absorption of human capital by academic cities in Poland. *Studia Regionalne i Lokalne (special issue)*, 59–76.
- Herbst, M., 2012. Edukacja jako czynnik i wynik rozwoju regionalnego. In: *Doświadczenia Polski w Perspektywie Międzynarodowej*. WN Scholar, Warszawa.
- Herczyński, J., Herbst, M., 2002. Pierwsza odsłona. Społeczne i terytorialne zróżnicowanie wyników sprawdzianu szóstoklasistów i egzaminu gimnazjalnego przeprowadzonych wiosną 2002 roku, Klub Obywatelski, Friedrich Naumann Stiftung.
- Israel, G.D., Beaulieu, L.J., 2004. Laying the foundation for employment: the role of social capital in educational achievement. *Review of Regional Studies* 34 (3), 260–287.
- KPRM, 2009. *Polska, 2030. Wyzwania rozwojowe* Kancelaria Prezesa Rady Ministrów.
- MRR, 2009. *Rozwój regionalny w Polsce. Raport 2009*. Warszawa, Ministerstwo Rozwoju Regionalnego RP.
- Parcel, T.L., Dufur, M., 2009. Family and school capital explaining regional variation in math and reading achievement. *Research in Social Stratification and Mobility* 27 (3), 157–176.
- Putnam, R., 1993. The prosperous community: social capital and public life. *American Prospect* 13, 35–42.
- Śleszyński, P., 2003. Uwarunkowania zróżnicowań przestrzennych wyników egzaminu gimnazjalnego w 2002 r., IGiPZ PAN: Warszawa.
- Theil, H., 1971. *Principles of Econometrics*. John Wiley & Sons, New York.
- Welt-Online, 2008. PISA Study Results. East German education outperforms West. *Die Welt*.
- Zarycki, T., 2000. Politics in the periphery: political cleavages in Poland interpreted in their historical and international context. *Europe-Asia Studies* 52 (5), 851–873.