Empirical Economics Letters, 21 (10): (October 2022) *ISSN 1681 8997*

Historical European Institutions, Human Capital and Development: A Plausible Exogenous IV Approach to Developed Regions

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Abstract: The literature on development has pointed out some deeply-rooted determinants of current economic development. Most research on the field has been devoted to developing countries or specific to single countries. We focus on deeply-rooted determinants of development of European regions, in particular on the influence of human capital. Following an identification strategy using a recently developed instrumental variable method for weakly exogenous instruments, we explore the historical links between current human capital and the presence of universities and trade guilds in medieval times, using a newly constructed database that we also describe. We show that human capital is an important determinant of income disparities across European regions.

Keywords: Development, Regions, Historical Determinants Of Development

JEL Classification Number: O18, B15, R11, N93

1. Introduction

The literature on the deeply-rooted determinants of development has been greatly developed in the last decade, and is mostly empirically based. Hall and Jones (1999) demonstrated the importance of social infrastructure, a composite measure of rule of law and other institutional measures. Glaeseret al. (2004), Rodrick et al., (2004) and Olsson and Hibbs Jr. (2005) followed that path, showing evidence for the importance of institutions and geography as determinants of economic development.

The effects of ethnolinguistic fractionalization were examined by Easterly and Levine (1997) and Alesinaet al. (2003). The influence of genetic diversity on ethnolinguistic fractionalization and development has been studied by Ahlerup and Olsson (2012) and Ashraf and Galor, (2013a, b). Moreover, the historical impact of sociocultural factors has been highlighted by Tabellini (2008), and Guisoet al. (2009).

Also, on the influence of historical institutions in current levels of development, Sokoloff and Engerman, (2000) and Acemoglu et al. (2005) have stressed the role of colonialism

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This work has been funded by national funds through FCT – Fundação para a Ciência e a Tecnologia, I.P., Project UIDB/05037/2020.

and inherited institutions. Galor and Klemp (2014) address the historical roots of human capital investments, based on genealogical records of a huge sample of Canadian households. They find that a predisposition towards investment in child quality establishes the incentives for long-run reproductive success and progress in education. Most of these contributions focus on the explanation of the current development of developing and poor countries or within countries (e.g., in Naritomiet al., (2012); Oto-Peralías and Romero-Avila, (2015), while we will focus on richer countries.

A different strand of literature explains, not the current levels of development, but historical levels, looking at wellbeing in the onset of (or previously to) the industrial revolution. That literature also seeks for historically rooted determinants of development, but the observed development is not the current one but the one observed sometime ago in history. Recent examples of this strand of the literature are in Cantoni and Yuchtman, (2014), De la Croix et al., (2020), Dittmar and Meisenzahl (2020), Pleijtet al. (2020), Pleijt and Van Zanden (2016), Andersen et al., (2017) and Baten and Van Zanden (2008). Most of these contributions found that human capital related variables found several centuries ago have been crucial drivers of institutions that were lately favourable to the economic take-off. One of the institutions analysed was in fact medieval university in De la Croix et al. (2020).

We crucially differ from that strand of the literature as we seek for determinants of current development but used historically rooted instrumental variables to help highlighting the exogenous influence of human capital. In particular, Acemoglu et al. (2014) explain differences in development of poorer countries and regions with the role played by human capital. We follow Acemoglu et al. (2014) in tracking the influence of human capital in the development. But, unlike those authors, we apply this approach to regions that were not colonized once, which are richer, are mainly European and have different historic traits. The word of Diebold and Hippe (2019) is a recent and close contribution to ours as it is concerned with the effect human capital in nowadays development. Instead as developing an instrumental variables approach, the authors explain differences in current levels of human capital and innovation with past variables, namely demographic and literacy measures in the XVIIIth and XIXth centuries.

We will seek to ascertain how important human capital is as a determinant of income disparities across European regions. In Section 2 we explain the data and its sources, the specification strategy, including the newly developed instrumental variables strategy. Section 3 presents regression results and Section 4 concludes.

2. Data and Specification

2.1. Data collection and instruments

We collected data from several sources. First, we used the database for regions made available in Acemoglu et al. (2014), containing current data for income and human capital (years of education). Geographical variables such as temperature and distance to coast were also taken from Acemoglu et al. (2014). As this database was used to study developing regions of the world, it did not include some variables for the developed regions, such as landlocked regions. Various other sources were used. For computing population density in 1500, using data from every major city in each NUT II in 1500, our source was Bairochet al. (1988).

Furthermore, we use the presence of medieval universities and corporation guilds in each region as instruments for human capital. Based on economic history (Cantoni and Yuchtman, 2014; de la Croix et al., 2018), we argue that those were foundations of accumulation and diffusion of knowledge. In fact, Cantoni and Yuchtman (2014) argue that law curricula in medieval universities, and the consequent development of legal and administrative institutions, were important channels linking universities and denser economic activity. Additionally, de la Croix et al., (2018) credit the emergence of guilds in Europe, and their intrinsic practices, such as journey manship, as main drivers Europe's rise relative to other regions in the globe, that continued to rely on family ties in training young people for professions.

Universitieswere centers of study and dissemination of scholastic knowledge, where state-of-the-art law, mathematics, geometry, astronomy, and also grammar, rhetoric and logic were shared among scholars and students (Willis, 1984). (Valero and Van Reenen, 2019), e.g. show that the increases in the number of universities are positively associated with future growth of GDP per capita, at the regional level. Using some historical data dating back to the XIXth century, Diebolt and Hippe (2019) find that regional human capital in the past is a key factor explaining current regional disparities in innovation and economic development. When compared with these contributions, ours rests on measuring the long-run effect of human capital on current regional development, using universities and guilds that were founded until the year 1500 to uncover the exogenous effect of human capital on per capita income.

Guilds are institutions that regulated apprenticeships and accordingly contributed to the development of state-of-the-art techniques in several professions (de la Croix et al., 2018). We argue that, for Europe, both ancient institutions (Universities and Guilds) are the most important predecessors of schooling and learning-by-doing, respectively. In turn, essential elements of human capital, and thus could serve as good instrumental variables to uncover the exogenous effect of current human capital in current income.

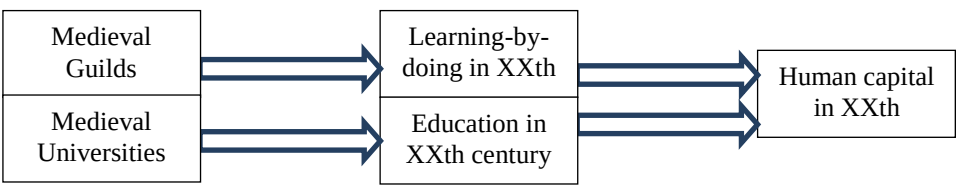
Additionally, a direct effect of the presence of those institutions far pre-dating the industrial revolution on current per capita income is unlikely to be found.

To collect data on the foundation year of universities we use the World Higher Education Database (WHED). WHED is an online database published by the International Association of Universities in collaboration with UNESCO. It contains information on higher education institutions that offer at least a three year or more professional diploma or a post-graduate degree. In 2010, there were 16,326 universities across 185 countries meeting this criterion. Our variables related to universities are dummies for the existence (with a 1 value) of a university in a given region for 1200, 1300, 1400, 1450 and 1500.

For Guilds, we used a very recent database build by Ogilvie (2019). This database includes information of the year of creation, town, and craft of each European guild. Our variables related to guilds are dummies for the existence (with a 1 value) of a guild in a given region for 1200, 1300, 1400, 1450 and 1500. For both Universities and Guilds, we reached the conclusion that the best instruments to be used for current level human capital are their presence in 1500.

A good instrument is one that is correlated with the instrumented variable (significantly) and one that isn't regarded as a good direct determinant of the outcome (or instrumented variable). As we have already argued, we should not expect a direct effect of the medieval universities and guilds in current income per capita. In fact, we argue that those pre-globalization institutions were determinants of greater incentives to accumulate human capital nowadays. At the regional level, those institutions shaped regional intellectual and entrepreneurship culture that persisted throughout centuries, leading the ground for learning-by-doing and knowledge institutions (see Figure 1).

Figure 1: Argument for the historically-rooted human capital institutions in Europe



Although the existing historical literature makes the link from guilds and medieval universities to schooling credible, there are the usual challenges to the exclusion restriction. First, despite the above arguments, there may still have existed a residual tendency for universities and guilds to be placed in areas that were more prosperous or that had greater development potential for other reasons. Second, medieval universities and

trade guilds may have impacted development today through other mechanisms than schooling. Our main response to these concerns is that to the extent that these potential omitted variable biases are important, they will lead to an upward bias in the estimated returns to human capital, and in our regressions we found a downward bias in OLS estimates.

Figure 2 and 3 show bilateral correlations and F-statistics between the century dummies for the presence of universities and guilds and human capital. This analysis highlights that among the possible dates in which medieval universities and guilds are observed, the 1500 dating is the most appropriate to use as instruments. Figure 2shows that correlations between those dummies and current days' human capital are increasing as the dummies progress from being dated in 1200 to 1500, with the ones dated in 1500 presenting the highest correlations. Also, these have p-values nearing zero. Figure 3 shows almost the same pattern using a F-statistic, although in this case for Universities the highest F-statistic is observed for the dummy for Universities in 1350. Combining both analysis we argue that there are strong arguments to select the dummies for 1500 to the baseline analysis. Table 1 presents descriptive statistics for the main variables used in the specification.

Figure 2: Correlations ρ and p-values with years of education

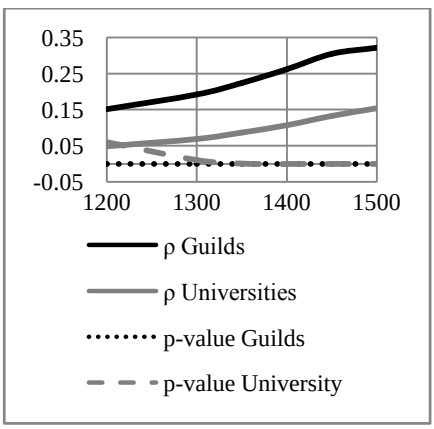


Figure 3: F-statistics from ANOVA analyzing differences in current human capital with dummies of medieval universities (left-hand scale) and guilds (right-hand scale)

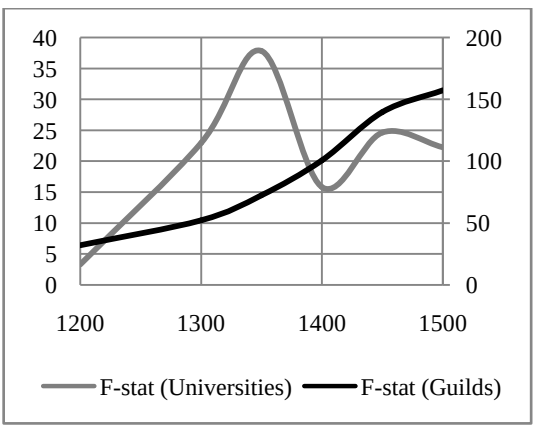


Table 1: Descriptive Statistics

	Avg	S.D	Min	Max	Correlation with Human Capital
Dependent variable					
GDP per capita	8.78	1.14	5.54	11.42	0.8157
Explanatory variables					
Human capital	6.99	3.08	0.22	13.21	--
Temperature	15.12	8.59	-12.73	29.15	-0.6420
Inverse Distance to Coast	0.85	0.15	0.33	1.00	0.1407
Population density in 1500	1.33	2.14	-9.58	6.62	-0.1213
Instruments for Human Capital					
Universities in 1500	0.019	0.14	0.00	1.00	0.1541
Guilds in 1500	0.069	0.14	0.00	1.00	0.3212

2.2. Specification

We estimate the following equation:

$$y = \alpha + \beta_1 edu + \beta_2 temp + \beta_3 temp^2 + \beta_4 inv.Dist.Coast + \beta_5 inv.Dist.Coast^2 + \beta_6 PopDens1500$$

where y is GDP per capita in 2005, edu is the variable of interest, years of education and β_1 measures the macroeconomic returns to education. It is worth noting that this coefficient is around 0.3 in the paper of Acemoglu et al. (2014) which applies to developing countries. Also, in the most robust cross-regions (instrumental variables) regression in that paper, the effect of human capital in income differences is not statistically significant (see e.g. their Table 10).

Other covariates are temperature (temp), temperature squared (temp^2), the inverse of distance to coast (inv. Dist. Coast), its square ($\text{inv. Dist. Coast}^2$) and the population density of the region in 1500 (PopDens1500). As mentioned above, the first four variables as well as the dependent variable come from the database available by Acemoglu et al., (2014). Population density in 1500 was constructed by us using data from Bairochet al. (1988) (see appendix). Throughout the paper, we discuss the introduction of population density of the region in 1500 (PopDens1500) as a direct determinant of current development and/or as an additional instrument for human capital. As a direct determinant of current development it acts as a past development indicator, which tend to correct for the possibility that the regions where universities and guilds were installed in 1500 were already the most developed regions in those countries.

3. Results: Plausibly exogenous IV regressions

Previous analysis show that the evidence according to which Guilds in 1500 is exogenous is not strong, although the Sargan and J-statistic tests do not reject.[1] Modern approaches to IV estimations tend to relax the exclusion restriction (see the influential paper of (Conley et al., 2012)). In fact, IV assumes that in the generalized regression $Y = \mathbf{X\beta} + \mathbf{Z}\gamma + \varepsilon$, $\gamma = 0$, meaning that the model assumes that the instrumental variables Z affect the outcome Y only through the endogenous variable X. In our application this is the same as saying that Guilds and Universities in 1500 only affect current development through human capital, an assumption that may be compromised by the marginally significant sign of Guilds in a regression in which Guilds may enter as an explanatory variable. Thus, we apply the plausibly exogenous methods to our regression Conley et al. (2012). Results are presented in Table 2. With those methods inference is informative even with a substantial relaxation of the exclusion restriction. Column (1) presents Union of Confidence Intervals (uci) method. In this method, we assume only that the support of γ is known and consider construction of confidence regions for β by essentially taking a union of $\gamma-$specific confidence intervals. Columns (2) to (4) present results from Local to Zero (ltz) approach. In this case, we view γ as a random parameter and assume beliefs about γ can be described by a proper prior distribution. Column (5) adds population density in 1500. As mentioned earlier, this despite reducing a lot the available data, can be interpreted as correcting for the existing level of development in 1500, the year where the instruments, guilds and universities, are counted.

The coefficient for education in regressions in Table 2 ranges from 0.329 to 0.560. This may be seen as an indication of the stability of our results across a set of different specifications.

Figure 3 presents the confidence intervals for the coefficient of education in the regressions of columns (2) to (5) for different levels of the standard-deviation of the presumed exogeneity $\gamma(\delta)$. In the first panel (a) of Figure 3, the education coefficient is about 0.5 and the confidence interval show that it can be valued from just below 0.3 to just below 0.7. In the second (b) and third (c) panels of Figure 3, the estimated coefficient does not change much but the confidence intervals range now from negative (near -0.5) to just above 1. This means that when including just one of the two instruments implied a lot more imprecision in the estimation. This also validates our approach to consider both

[1] Results are available upon request.

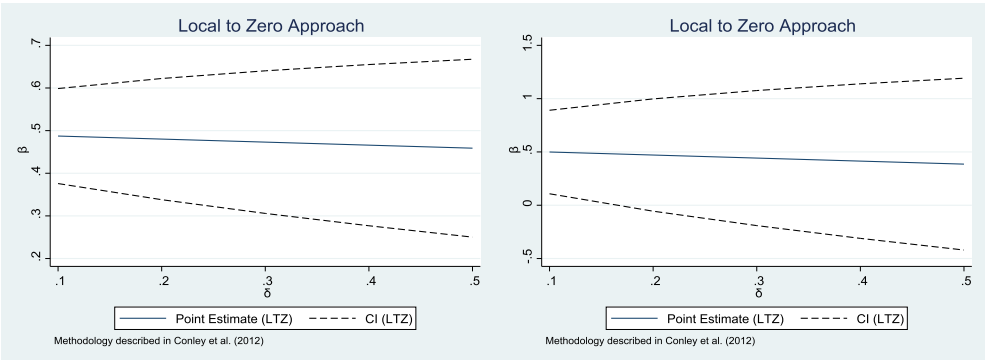
instruments to capture the exogenous contribution of education. Finally, when population density in 1500 is included in regressions – in panel (d) of Figure 3, results change little when compared with the ones in panel (a).

Table 2: Plausible Exogenous IV regression

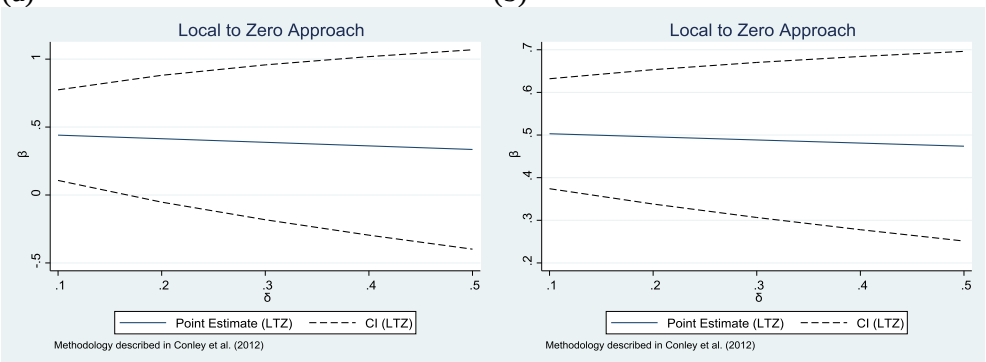
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
Dependent variable: GDP per capita					
Method	**uci**	**ltz**	**ltz**	**ltz**	**ltz**
Years of education	[0.329***; 0.560***]	0.436***	0.524***	0.435***	0.437***
	(0.083)	(0.040)	(0.095)	(0.039)	(0.054)
Temperature	[-0.003; 0.055***]	0.024*	0.033**	0.024*	-0.048***
	(0.0106)	(0.013)	(0.016)	(0.013)	(0.012)
Temperature^2	[-0.001***; 0.0015***]	0.000	0.001	0.000	0.007***
	(0.0003)	(0.000)	(0.001)	(0.000)	(0.001)
Inv. Distance to coast	[2.685*; 10.749***]	6.452***	7.601***	6.389***	-3.652**
	(1.558)	(1.845)	(2.248)	(1.819)	(1.590)
Inv. Distance to coast^2	[-7.047***; 1.345]	-4.007***	-5.107***	-3.957***	2.526**
	(1.027)	(1.227)	(1.682)	(1.204)	(1.067)
Population Density in 1500	--	--	--	--	1.492
					(1.411)
Number of Observations	1352	1352	1352	1352	534

Notes: Heteroscedastic consistent standard-errors in parenthesis are in the line below coefficients values. *** indicates statistical significance at 1%, 5% and 10% levels respectively. Priors are from column (7), Table 2. Column (1) presents uci (union of confidence intervals). Columns (2), and (5) present ltz (local to zero) estimates using a normal distribution. Column (3) and (4) presents ltz estimations using a normal distribution in which only universities in 1500 enter as instrument and in which only Guilds in 1500 enter as instrument, respectively. A constant is included on the models but not shown in the Table.

Figure 3: Confidence intervals corresponding to regressions in columns (2) to (5) in Table 4



(a) (b)



(c) (d)

4. Conclusions

In this paper we readdress the relationship between human capital and development, which has been a well discussed issue in development economics. However, we approach it in from a different perspective from what has been done so far. First, instead of studying the effect of human capital in the developing world, we do that in developed regions of the world. Second, we address the exogenous component of current human capital as a determinant of development linking human capital to its pre-globalization existing institutions: medieval universities and guilds. Such institutions have been pointed out by economic historians as potential determinants of a changing path of the European development. Notably, when compared with other regions of the globe that, in the pre-Colombian era, were at least as developed as Europe, institutions as Guilds may have made the difference in the transmission of knowledge (De la Croix et al., 2018). Inspired

by this, we use them as instruments for human capital. We reached not only very robust effects of human capital but also econometric validation of the approach. Furthermore, we use the plausible exogenous approach, which deals with possible violation of the exclusion restriction.

In a quantitative reading of effects, it may be said that more one year of education, on average, in region A (Europe), would imply nearly 44% to 55% more GDP per capita than in region B (developing), ceteris paribus. This indicates a very sizeable quantitative effect, highlighting the importance of human capital in the most developed regions in the world.[2] This effect is important to the literature in three main aspects. First, human capital seems to be even more crucial for richer regions than for the underdeveloped regions studied by Acemoglu et al. (2014). Second, in our case, the instrumental variables approach we used yielded higher coefficients that the OLS approach, which is an opposite relation to that obtained by Acemoglu et al. (2014), implying that, in our data, measurement error in human capital (years of schooling) is more relevant than reverse causality and omitted variables as the source of the OLS inconsistency. Third, our results give further support to the use of the presence of medieval universities and guilds as historical instruments for current levels of human capital, even if we relax the exclusion restriction. This adds to recent and ongoing research that has been focusing on the importance of historically determined conditions, institutions and practices in explaining present-day differences in economic development.

Looking ahead, there are several prospects for future research. Firstly, deepening the knowledge about the relationship between pre-Colombian institutions linked to learning, and contemporary measures of human capital may be pursued using different measures about medieval universities and guilds. In fact, the information about medieval universities and the level of detail about guilds seem promising. In future work, we may also use this new database to ascertain the effect of different types of guilds and changing types of universities (e.g. from scholarly to church dominated). This might yield a more exact pattern of the influence of those institutions on the incentives to accumulate human capital, and their consequences in terms of current development.

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[2]It is also consistent with some of the most recent micro evidence on returns to education in Europe such those in Badescu et al. (2011) and Depalo (2017). Although these comparisons between macro and micro effects may be made with cautiousness as the first may include long-run externalities.

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Data Appendix

For the Universities dummies taking value 1 for existence in a given date, we considered only those which have been working continuously until now, constructing dummies for the Nuts2 regions, in terms of presence of at least one institution in the years 1200, 1300, 1350, 1400, 1450 and 1500, of which with used just the 1500 dummies, having checked facts at the WHED database.

For the presence of Guilds dummy taking value 1 for existence in a given date in the regions all through the same years as the Universities, we used the database kindly made available by Ogilvie ,2019) at http://www.econ.cam.ac.uk/people/ faculty/sco2/projects/ogilvie-guilds-databases. Those two variables may be interpreted as antiquity (or foundation century) of those specific institutions.

To construct our population density variables, for each of the Nuts2 Regions in Acemoglu (2014)'s database, we collected the population of the biggest city (equal or over 2.000 inhabitants), and summed that with all other entries of cities above the same threshold. Besides the numbers Bairoch did say for 1500, whenever there was a blank in that century, but a series of values in either of the next two centuries (1600, 1700), we decided to fill the 1500 blank as although cities did move or cease to exist, it was improbable that they

should of 'appeared from nowhere' with a significant level of population. Having set the threshold for relevance in the entries for 1500, on 2.000 people, the value at 1600 was 5.000 inhabitants or more, of which we considered that at least 2/3 or 3.000 probably lived there in 1500. For 1700, we took in blanks in 1500 and 1600 when the population in 1700 was 8.000 or more, of which we considered that at least 2/3 squared or 4/9ths probably lived there in 1500. We started with Albania with for entries, the biggest of which, Voskpoje, had 30.000 in 1600, and a blank in 1500, which we filled with 20 (for 20.000 inhabitants). Austria had 8 entries, but Belgium 34, in 11 regions. Germany had 126 entries, in 15 of its 16 Länder (States) – Saarland had no cities within our threshold in 1500. In all 39 countries, it was in Germany that we added a single entry to those of Bairoch – that of Mühlhausen, in the State of Thuringia – which we came across through cross-references and which, apparently was an important city in the middle ages, belonging to the Hanseatic League, with an estimated 10.000 inhabitants in 1500, see3. That made it the second largest city at the time in Thuringia, after Erfurt. France's 22 regions, yielded 87 cities; Poland's 16 regions had 31 cities over 2.000 inh.; Spain's 19 regions, had 139 cities; form Netherland's 12 regions, 10 had a total of 33 entries. Italy's 20 regions had 178 cities qualifying for entry. Great Britain's 12 regions had 56 cities, and Portugal, had 27 cities in 7 regions/Island Groups. To complete the data for population density, area was, essentially collected from Eurostat (Total and land area by NUTS 2 region [TGS00002]), supplemented by data from the region itself, when lacking.

[3] See Stahn, Dina (2009). Thüringen (German). Karl Baedeker Verlag. ISBN 978-3-8297-1175-3.