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Geographic aspects of inequality and poverty

By Uwe Deichmann

January 1999

Text for World Bank's Web Site on Inequality, Poverty, and Socio-economic Performance:
http://www.worldbank.org/poverty/inequal/index.htm

About Poverty Maps

What do we mean by geographic aspects?

Poverty analysis is often based on national level indicators that are compared over time or across countries. The broad trends that can be identified using aggregate information are useful for evaluating and monitoring the overall performance of a country. For many policy and research applications, however, the information that can be extracted from aggregate indicators is not sufficient. Researchers and policy makers therefore increasingly collect or construct geographically disaggregated indicators that provide information about the spatial distribution of inequality and poverty within a country. Such data sets are sometimes called "poverty maps" since they allow the visualization of the incidence and magnitude of poverty across space. These pages discuss briefly why geographic aspects of inequality and poverty have become an important component of poverty research and policy analysis, how poverty maps are constructed, what their limitations are, and how they can be used in research and policy making.

How are poverty maps constructed?

Poverty and inequality are multidimensional issues. Although monetary indicators—consumption and income—are widely considered as the most reliable measures of poverty (e.g., Glewwe and Gaag 1988), social and structural indicators describe facets of human wellbeing that are not easily captured by purely economic measures. The table below provides some examples of monetary and non-monetary indicators of human welfare (after Henninger 1998). All of these – or other – indicators can be the basis for the construction of high-resolution spatial maps.

The table distinguishes between status and outcome indicators. The former describe the condition of a person or household. Examples are their income level with respect to a chosen benchmark or whether the household has access to basic services such as safe drinking water. Outcome indicators, in contrast, focus on the consequences of achieving or failing to achieve a secure or sufficient welfare status in one or more indicator dimensions. Examples are anthropometric measures such as a low weight-for-age measure which is a consequence of insufficient caloric intake. The distinction between status and outcome indicators is not always clear-cut, since there are strong interdependencies between different aspects of welfare. For example, low income can

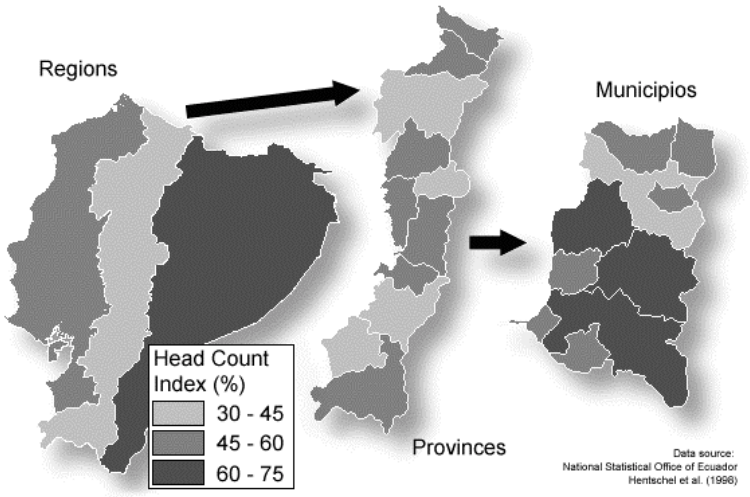
be both a cause and an effect of low education and poor health (Ravallion 1996). Socioeconomic assessments typically include both status and outcome variables.

		Example indicators	
Dimension	**Sector**	**Status**	**Outcomes / consequences**
Economic	Consumption and income	Head count index; poverty gap	Productive assets; housing
Social	Nutrition	Caloric intake to requirement	Children's weight-for-age
	Sanitation and water	Access to safe drinking water	Morbidity due to water-borne diseases
	Energy	Access to electricity / fuelwood	Nutritional or educational indicators
	Health and family planning	Access to primary healthcare	Infant mortality rates
	Education	Primary school enrollment rate	Literacy rates
Enabling environment	Access to opportunities	Access to land, credit; participation in decision making	Productive assets; income from agricultural surplus or non-farm activities
	Natural endowment	Agro-climatic variables	Measures of agricultural productivity and food security
	Geographic infrastructure	Access to markets	Income from sales of agricultural surplus

Why are poverty maps important?

Capturing heterogeneity within a country

Aggregate, national level indicators give the impression that conditions within a country are uniform. In almost all countries this is not the case. Significant geographic variation in the incidence rates of poverty may be due to differences in resource endowments, education and health services and a host of other reasons discussed below. As a consequence, inequality exists between regions as it does between individuals. As we map indicators for higher resolution administrative units, geographic variability that was hidden in the aggregate data becomes apparent. This is illustrated in the maps below that show the head count poverty index at various level of aggregation in Ecuador. The head count index is a common poverty measure that indicates the proportion of the population whose consumption level is below the poverty line.



Identifying geographic factors that influence poverty

Detailed information about the distribution of the poor enables us to investigate whether the spatial disparities in living standards have been caused by geographically defined factors. For instance, agro-ecological resource endowment, access to input and output markets, and availability of educational and health facilities all influence the well being of households. In addition to household survey data and especially in panel form, small area data on poverty thus also allows to test hypotheses concerning the cause-effect relationships between geographic factors and the level of well being.

Improving targeting of resources and interventions

Poverty maps are becoming important tools for developing effective policies aimed at reducing inequalities within countries. In designing intervention schemes and allocating subsidies, resources will be used more effectively, if the most needy groups can be reached effectively. This reduces the leakage of transfer payments to non-poor persons (Type I error), and it minimizes the risk that a poor person will be missed by a poverty alleviation program (Type II error). Detailed information on the location of target groups is thus often a key ingredient for effective projects.

This being said, all poverty maps will have a certain error attached to them which should be taken into account by practitioners. Generally, poverty maps need to be validated and accompanied by independent sources of information.

Improving communication about poverty conditions

Poverty maps also have an important role in communicating information on inequality within a country. Maps are a powerful tool for presenting information in a way that is easily comprehensible by a non-specialist audience. Maps encourage visual comparison and make it easier to look for spatial trends, clusters or other patterns. Maps are therefore useful not only to governments and decision makers, but also to the local communities. Compiling disaggregate

information on human welfare generates locally relevant information. This provides local stakeholders with the facts that are required for local decision making and for negotiation with government agencies. Poverty maps thus become an important tool for local empowerment and decentralization.

Sources of small area data

Population and housing censuses

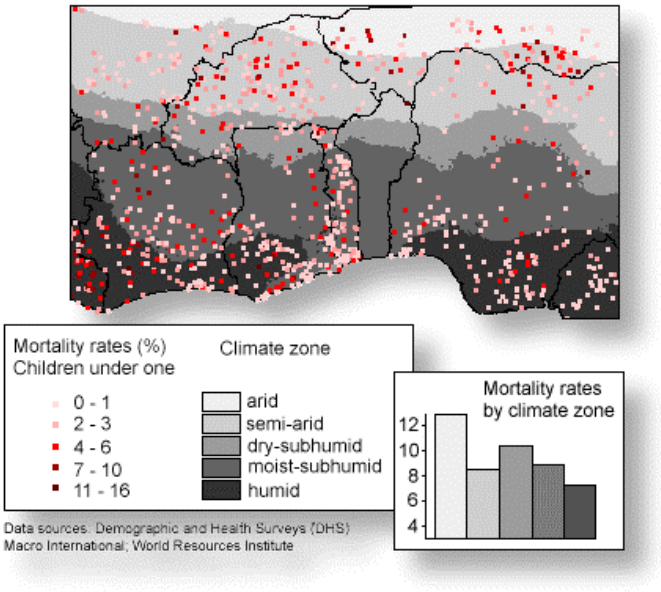
Unfortunately, detailed geographic information on socioeconomic indicators is often difficult to obtain. The main sources of such information are censuses and surveys. In the absence of a civil registration system, population and housing censuses remain the only source of information for all inhabitants and households in a country. Census data can be compiled for small statistical or administrative areas or for communities, villages and towns. However, since census taking is expensive a census is conducted only once a decade in most countries. Also, census questionnaires must be concise to allow data collection in the entire country during the enumeration period—usually a single day. The number of indicators that are collected is therefore limited. Economic information such as income and consumption, in particular, is rarely available from a census. Even so, census information remains one of the most important sources of information on demographic and social conditions in a country (see United Nations 1998).

Surveys

Surveys, in contrast, are considerably more comprehensive—often resulting in several hundred indicators. Two examples of comprehensive household survey programs are the World Bank's Living Standards Measurement Surveys (LSMS) and the USAID funded Demographic and Health Surveys (DHS). The former concentrate on economic aspects of well being such as income and consumption, while the DHS focuses mainly on measuring health indicators. These include anthropometric measures that reflect the adequacy of food supply and health care. Surveys provide information for a randomly selected set of households or individuals. Because of the limited sample sizes, aggregation of sample survey results does not usually yield statistically reliable information for geographic reporting units below the provincial or regional level. Surveys are therefore not a reliable source of small area information on living standards.

Yet knowing such caveats, survey results can still provide useful geographic information. The map below, for example, shows child mortality estimates for sample survey clusters in West Africa (see Croft *et al*. 1997). Such maps provide a cross-sectional view of indicators of well being. Interpretation of sample survey data must be done with great care, however. Each point on the map represents a relatively small number of households in a randomly selected village or small administrative area. The summary value at each particular location may thus not accurately reflect conditions in the surrounding area. While mapping survey sample data can help identify

general geographic trends, these maps should therefore not be used to draw conclusions about the status at a specific location in the country.



An important benefit of mapping survey sample data is that measures of well being can be linked to other spatially defined information. With the aid of a geographic information system (GIS; see below), knowing *where* a sample cluster is located allows aggregation of survey data for regions other than administrative units. For example, health outcome indicators can be aggregated for biophysically defined units such as agroclimatic zones or for regions classified according to their access to infrastructure and services. The geographic location of sample survey points also serves as an indexing system. This allows us to extract auxiliary indicators that were not included in the survey instrument, but that may provide important clues about the distribution of poverty. For example, GIS operations can determine for each survey cluster the distance to the nearest market town, the agroclimatic conditions surrounding it, or the number of schools or health facilities in their vicinity.

What is a GIS?

Geographic information systems are computer software programs designed to handle geographically referenced data. They are essentially database management systems that use geographic location as a reference for each database record. Location can be used to integrate information from heterogeneous sources, for example to find for each village in a region the mean annual rainfall or soil quality information within a 20 kilometer radius. A GIS can also generate information to test hypotheses about neighborhood relationships. For instance, we can examine whether neighboring farmers tend to share similar household characteristics, which may point to the existence of significant clusters caused by some other factors, diffusion processes or spatial

spillovers. Finally, GIS provides powerful visualization tools that facilitate analysis of geographic data and improve communication of analysis results and policy recommendations.

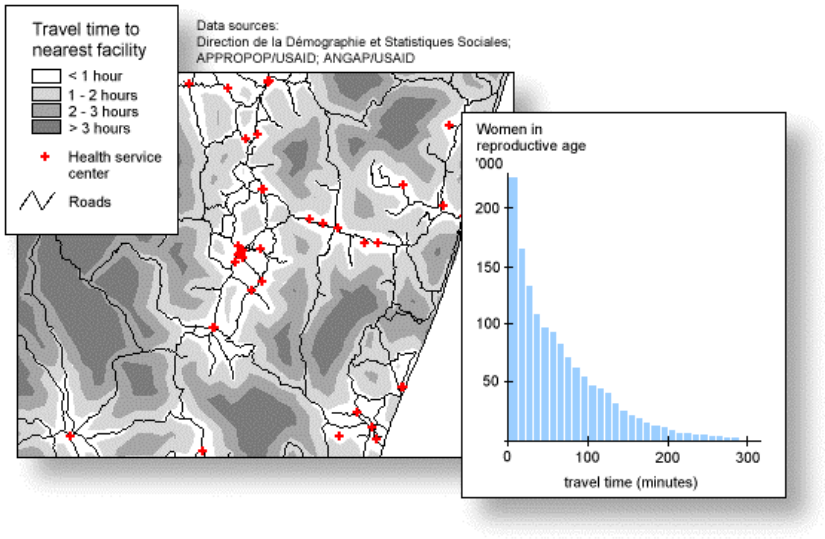
Auxiliary data sources

To capture some of the additional aspects of inequality, researchers increasingly turn to geographically referenced data sources to construct indicators that are not easily measured in a survey or census. An analyst can use GIS tools to extract information on, for example, agro-climatic suitability or the probability of crop failures which indicate a rural community's susceptibility to food shortages. Communities living in areas of high vulnerability to external climatic shocks will have a low safety margin even if their income or consumption in any given year is slightly above the poverty line.

Food security and vulnerability are related to poverty and inequality issues, since people with weak economic resources tend to be more strongly affected by crop failures or increasing food prices. This relationship may not always hold, however. For example a subsistence farmer may be classified as poor based on income, but will not be vulnerable to changes in food prices.

Several major initiatives have developed monitoring systems to assess food security and coordinate drought relief operations. Two examples are USAID's Famine Early Warning System (FEWS) and the Food Insecurity and Vulnerability Information and Mapping System (FIVIMS) coordinated by FAO (see Wright *et al.* 1995; and Henninger 1998 for an overview). These systems generate comprehensive, spatially referenced databases on indicators that are related to the level of human well being in the target regions. So far, however, there has only been limited integration of economic poverty analysis and food security and vulnerability mapping.

A second example of the use of GIS to generate auxiliary information is in measuring accessibility. Access to markets and services is partly determined by the quality of public infrastructure. Using high resolution census data, information on transport networks, and the location of service centers, an analyst can estimate, for instance, the proportion of the population that lives within an acceptable distance or travel time from a school or health clinic. The map below for example shows the number of women in reproductive age groups by travel time from health centers that offer reproductive services in a region of Madagascar. The resulting indicators of equity in access to services are useful for efforts to improve public infrastructure.

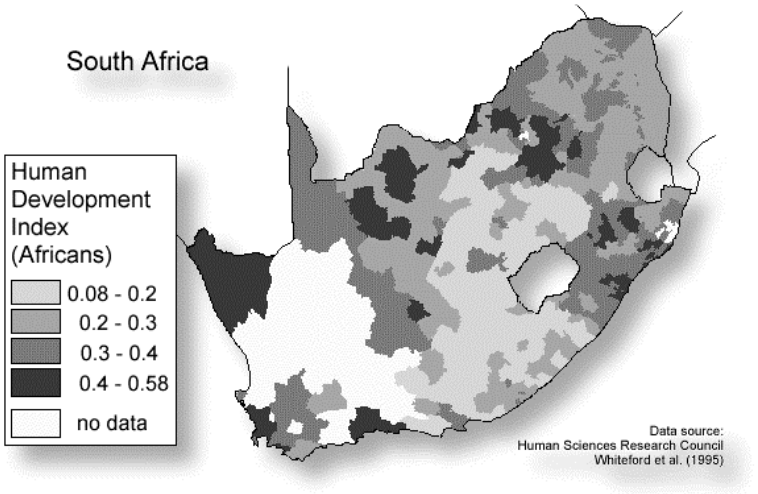


Although factors other than distance or travel time such as quality and cost of services also determine actual use of service facilities, geographic parameters have shown to be significant in predicting service utilization especially in rural areas. Measures of accessibility which can be generated relatively easily can therefore play a useful role in informing policy analysis—for example in determining gaps in service provision and the location of new facilities. In research applications, such information is useful in assessing the impact of infrastructure and service provision on levels of human well being.

Aggregate multidimensional indicators

Other approaches to the geographical analysis of poverty do not rely on one data source alone. For example, combinations of monetary and non-monetary indicators have given rise to a number of composite measures of human welfare. One approach is to create an index of well being as a weighted sum of the values of relevant variables. Alternatively, instead of the actual value of the indicator, the observation's rank in each indicator dimension is sometimes aggregated. Examples of such multidimensional summary measures are the basic needs indicators produced by several Latin American statistical offices to rank regions of the country according to their level of welfare. These combine, for example, information on access to safe water, sanitation, the level of education and housing conditions into a single indicator. Each of these variables can usually be obtained from the census. A basic needs indicator value can therefore be derived for small geographic areas.

Another well-known example of a multidimensional indicator is UNDP's Human Development Index (HDI). The HDI is a relative index based on measures of life expectancy, education (literacy) and income, with high values indicating a high level of human development. While most often used as a country-level indicator in international comparison, an HDI can also be produced at the subnational level using sufficiently detailed survey or census data (see map below).



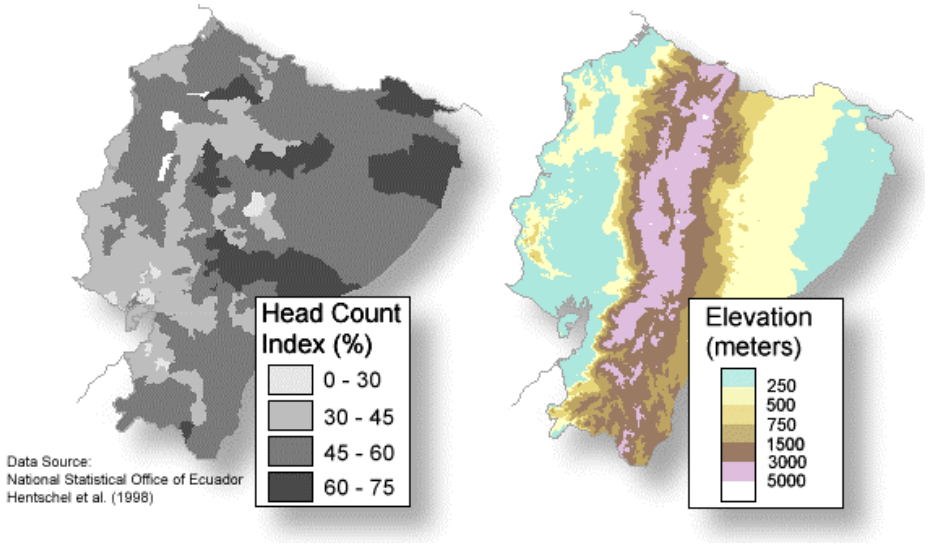
While composite indicators recognize the multidimensional nature of poverty and inequality, their weakness is that there is often no objective basis for selecting the weighting or ranking schemes on which aggregation is based (Ravallion 1996). This makes basic needs and human development indicators difficult to interpret. The ad hoc nature by which many aggregate indicators are constructed can seriously impede their usefulness in policy analysis. Studies have shown that, for instance, a basic needs indicator and a comprehensive consumption measure may produce very different welfare rankings of households or geographic regions (Hentschel *et al*. 1998). Aggregating individual measures also hides important sectoral information that can be used to select specific policy interventions.

The most promising route of inequality is therefore to recognize the multiple dimensions of deprivation but to describe these dimensions separately. For example, spatial maps can be used to overlap income-poverty, malnutrition, and access maps to assess joint correlations or disparities.

Indirect estimation of poverty indicators

Other approaches combine the depth of information in a survey with the complete spatial coverage available from a census and from auxiliary GIS data sources. One option is to statistically estimate a widely accepted general measure of poverty and inequality such as income or consumption. For example, if a suitable household survey is available, a relationship can be estimated between household consumption and a number of explanatory variables such as housing size and quality, education level of the head of household and so on. Provided that the same explanatory indicators are also available from the census, one can then apply the estimated relationship to the household level census data to predict the expected poverty level for each household in the country. This allows the production of a consumption-based poverty indicator for small areas. Indirect estimation enables the analyst to sidestep the limitations of censuses (no consumption data) and of surveys (insufficient sample size for small area aggregation). This approach has been implemented by Hentschel *et al*. (1998) for Ecuador using a survey of living standards and data from the population and housing census (see map below). Other countries

experimenting with the approach are South Africa, Panama, and Nicaragua. A review of statistical small-area estimation techniques is presented by Ghosh and Rao (1994).



The statistical estimation of poverty indicators can be extended to include explanatory factors that are not included in the census or survey. Bigman *et al*. (1999), for example, estimate poverty indicators at the community or village level in Burkina Faso. The dependent variable is a consumption measure available from a household survey. Explanatory information includes survey and census data as well as GIS derived indicators on climatic suitability, the number of livestock per capita, the distance to the nearest health facility, and the number of water pumps per community. The estimated relationships are then used to predict household consumption for all villages in the country. The resulting indicators can be used to rank villages according to their level of well being. This in turn provides valuable information to policy makers that guides resource allocation in poverty alleviation schemes.

Given that indirect estimation of poverty indicators tends to imply some degree of uncertainty, it is generally not advisable to base targeting on one (estimated) measure alone. Geographic targeting is an interdisciplinary exercise that must take account of the multidimensional nature of poverty and inequality. Estimated poverty indicators should thus be accompanied by information that describes more general characteristics of the communities targeted such as availability of public services, access to economic opportunities, disease incidence, agricultural potential or threat from natural hazards.

How are poverty maps used?

Mapping as a policy development tool

The most obvious use of a poverty map is to identify areas in a country in which development has been lagging behind. Regional disparities of living standards exist in most countries. Maps that show indicators of well being can help identify those regions that may benefit most from

additional resources, for example through investments in public infrastructure that will improve economic opportunities for the local population. Poor areas may also be selected to receive some form of direct transfer payments, for example in the form of subsidized credit, funds for public works, food-for-work programs, or direct local administrative budget subsidies.

Generally, different forms of targeting are distinguished: geographical targeting in which broad allocations of resources are made, individual assessment mechanisms in which households or individuals have to fulfill certain criteria to be able to participate in social programs, and self-targeting in which the design of the program itself appeals only to a certain population group. Very often, different targeting mechanisms used to be continued for effective program execution.

Poverty maps are important tools for *geographical targeting* where resources are directed towards areas that have been identified as poor (Baker and Grosh 1994; Bigman and Deichmann forthcoming). An advantage of geographical targeting is that it requires relatively low administrative costs. Indirect estimation of geographically referenced indicators of well being tends to be less expensive than detailed surveys, monitoring systems or means testing. Furthermore, if an existing set of small areas is used as the basis for poverty maps, resources can be channeled through the existing administrative structures such as county, district or municipal governments. However, and as mentioned above, geographical targeting is often only one in many policies to reach intended beneficiaries.

Geographic targeting needs to take advantage of all available data sources. Rather than relying on rankings based on a single aggregate or estimated welfare indicator, a comprehensive poverty measure can be compared against regional patterns of other economic, social or biophysical indicators. For example, a poverty map can be overlaid with geographic information on access to health care. This will not only inform decision making on *where* to expand health services, but also on *how* to implement a health sector program—for example, by subsidizing health care in poor areas and using some form of cost recovery in less-poor regions (Hentschel *et al*. 1998).

Research has shown that geographic targeting can be very effective, since poor households tend to be concentrated in specific areas. However, the effectiveness of the program depends greatly on the level of geographic detail at which targeting decisions are made. The smaller the geographic regions for which indicators of well being are available, the greater will be the effect of transfer payments or benefits on poverty reduction. Studies in India and Indonesia, for example, have shown that states or provinces are too heterogeneous for targeting to be effective (Ravallion 1994). This clearly shows the importance of collecting, compiling and publishing statistics for *small* areas. For example, national statistical agencies should make census data available at the lowest geographic aggregation that does not compromise data privacy. Sample surveys should be designed with some consideration of geography to ensure sufficient spatial coverage as well as statistical significance of survey data at relatively low levels of geographic aggregations. This requires a combination of population based sampling with a spatial sampling design.

Mapping as a research tool

Information on the spatial distribution of poor people can significantly improve the design of projects aimed at poverty alleviation. In the long term, however, the goal needs to be to identify and address the root causes of poverty. From a geographical perspective therefore, the fundamental question is why poor regions exist at all (Ravallion and Wodon 1997).

Current research provides two lines of explanation which, most significantly, differ in terms of their assumptions about migration behavior and labor mobility (Crump 1997). *Individualistic* explanations assume that people are highly mobile. Poor people tend to remain in poor areas because of specific wage or price incentives, or because they believe that they have a higher chance of making a living in a less competitive environment. In this model, poor areas result from individual behavior. Characteristics of poor areas such as low rents, poor infrastructure, limited services and a lack of economic opportunities are thus considered a reflection of individual decisions by the poor to live in that area.

Structural explanations, also termed geographical models, in contrast, argue that there exists a causal link between geography and the level of well being. Mobility is seen as limited and structural differences between regions in terms of natural resource endowment, infrastructure and access to services therefore tend to persist and intensify. There is some empirical evidence that "geographic capital" does indeed have a strong relationship with poverty. Jalan and Ravallion (1997) for instance, showed a significant influence of structural geographic variables on well being while controlling for differences in household education and other human capital variables. This points to the existence of so-called *spatial poverty traps*, where poor resource endowments lead to limited access to educational, social and economic opportunities thereby further increasing the differences between poor and better-off areas.

Empirical testing of structural theories requires quality information on a suitable outcome variable—such as a carefully constructed or estimated poverty indicator—and on human and geographical capital variables. Much of this information can be based on the poverty mapping approaches reviewed earlier. More empirical evidence on the validity of these theories will improve the design of policies. Small area poverty and inequality data will also allow for a host of other research which is often carried out at the country-level only. For example, continuing local level inequality statistics with individual health outcome data will allow for testing the influence not only of the level of personal income on health but also of inequality. Similarly, researchers can examine whether local level poverty and inequality influences educational outcomes or – by determining local power structures – the community-level choice variables (such as projects demanded of Social Investment Funds).

Key readings

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