

Overview of Datasets for Environmental Compliance and Enforcement

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1 INTRODUCTION

What sources of data are there for those who would study environmental compliance and enforcement (ECE)? One of the significant challenges that ECE researchers perpetually face is the lack of relevant and reliable data. Frequently, before researchers can delve into the particulars of answering any specific research question they must first go out and collect¹ the raw data they need for their analysis.

This situation is slowly starting to change. While a paucity of data remains problematic for some issues or areas, there are an increasing number of datasets which contain valuable information for the ECE researcher. This paper will survey some of the major datasets, describing their origin, authors, scope, contents, and applicability. The paper divides up the datasets into 5 categories: statistics, surveys, indicators, indices, and regime datasets, and devotes a section to each category, introducing general concepts and then moving on to describe a few of the major datasets. The flow is from the more global and general, starting with datasets on international regimes, and moves towards the more local and specific, ending our overview with statistical datasets.

2 INTERNATIONAL REGIME DATASETS

Many political scientists have conducted research on multilateral environmental agreements (MEAs) in order to better understand institutions: how institutions arise, what makes them effective, and, more recently, the dynamics of how they change and adapt. While much of this work has been of a qualitative nature, with more focus on case studies, more recently some researchers have begun performing quantitative analyses. These analyses required more formalized datasets with which to work, and this has led to several researchers creating databases of information on international environmental regimes. While there are still only a few these, and most of them are relatively new, they hold much promise as a rich domain for research on what influences compliance and enforcement in international environmental regimes. This section surveys some of the major MEA datasets.

2.1 Background: The challenge of judgmental assessment

Before starting into the datasets themselves, however, it is useful to consider the challenges facing researchers who must construct them. Many of the measures of environmental compliance and enforcement are not straightforward, physically measurable quantities. While we may be able to quantify an amount of oil spilled, or CO₂ emitted, or even (given sufficient resources) the number of specimen of endangered species taken, sometimes we will be dealing with relative measures of success or failure that do not lend themselves to easy measurement. This is particularly true at the most macro-level for those in regime analysis who consider the impacts of multilateral

¹ Or, for some researchers, code.

environmental agreements (MEAs).² Thus, before we start in with a list of international datasets, it will be helpful to understand the conceptual challenges that are involved in constructing many of them. This selection by Underdal discusses these challenges and acquaints us with some of the techniques researchers use when facing them.³

Methods of Analysis

Arild Underdal, 2002

Measuring Single Variables

One major challenge for empirical research on international politics is that many of the key variables identified in models and theories call for what might be called *judgmental assessment* rather than straightforward observation and measurement. A variable such as the number of houses built in a certain region during a particular period of time can be determined by simple counting. By comparison, measuring the effectiveness of a particular regime or the political malignancy of an environmental problem leaves a much larger role for subjective judgment.⁴ Since it is usually very difficult to formulate an exhaustive set of precise rules and operational criteria to guide such judgmental assessment, the process tends to become less transparent, and the results less reliable. This makes it all the more appropriate to try to explain the guidelines that we have followed ... in assigning scores on ... variables that do not lend themselves to straightforward measurement.

...

Normally, consistency in interpretation and measurement is more easily obtained in *intra-* than in *interregime* analysis.⁵ It is, for example, by and large easier to determine whether the effectiveness of a particular regime has increased or decreased over time than to determine whether one regime is more or less effective than another. Furthermore, the difficulties involved in comparing scores across regimes tend to increase as the variation in substantive issues that the regimes are intended to address increases. Thus, it is easier to compare two regimes dealing with pollution control than to compare a pollution regime with, for example, one established to manage marine living resources. We have tried to minimize these problems by keeping ambitions at a modest level: in no instance do we attempt to move beyond *ordinal*-level measurement,⁶ and for all our key

² Indeed, it is frequently true throughout social science research.

³ A brief note about the footnotes is required here. Footnotes throughout the paper are presented in strict numeric order, including the original footnotes from excerpts (all of which have been retained). Within excerpts the original footnotes are distinguished by opening with a bracketed note containing the footnote number from the original reading. Thus footnote 3 in this paper was originally footnote 2 in Underdal's discussion of methodological challenges.

⁴ [Ft. 2] The difference, though, is a matter of *degree* rather than one of principle. Few if any of the variables used in social science research leave *no* role for judgment. Thus, in counting the number of houses one may well have to make judgmental decisions about, for example, whether a certain building satisfies the defining characteristics of a house or whether it should be counted as a single unit or more.

⁵ [Ft. 4] One reason, of course, is that in this study each regime is analyzed by a single author. Consistency is normally easier to achieve at the *intrapersonal* than at the *interpersonal* level.

⁶ Researchers and statisticians work with several variable types: Nominal variables fit into categories which have no natural order or hierarchy. Gender is a classic example (male or female); primary language is another (English, French, Chinese, etc.). Ordinal variables can be grouped into categories for which there is a hierarchy or natural order, but not one with defined intervals. For example, the quality of service at a restaurant might be rated as: Excellent, Good, Acceptable, Fair, and Poor. These categories have a natural order. However, regardless of how a researcher codes these variables, there is not a measurable distance between categories. Thus while for coding purposes we might set Excellent=5 and Poor=1, this does not imply Good service is twice as good as Fair service. All we can say is that Good > Fair (i.e. 4>2). Numeric interval variables are measurable values which take on discrete values. Household size is a good example. Obviously you can evaluate the distance between values in this system (i.e., a 4 –person household is half

variables we limit the number of categories to three or four. These measures do not solve the basic problem, however. As a general rule of thumb, it therefore seems prudent to place more confidence in conclusions from intraregime analysis than in comparisons across regimes. However, the former cannot be a general substitute for the latter; some important questions can be answered only by interregime comparison.

From Verbal Description to Numerical Scores

...[W]e would like to pause for a minute to reflect on an interesting experience that we have had in translating qualitative description into numerical scores. With a few notable exceptions, colleagues and practitioners alike have been significantly more critical of the numerical case accounts than they were of the verbal or qualitative descriptions—even when the two contain the same pieces of information. ... This observation leads to an interesting question: what in the numerical format tends to generate skepticism and criticism not provoked by a purely verbal presentation of the same information?

We suspect that part of the answer may be found in a misconception of the level of measurement involved—more precisely, a belief that numerical scores must refer to at least interval-scale data. This is not correct; numerical scores can, of course, be used to represent even nominal-scale distinctions.⁷ ...

Second, the numerical format itself is probably seen as more constraining and demanding. It is perceived as more constraining in that it offers not only a finite set of variables but also a finite set of predefined categories for each variable. In the purely verbal mode of description, students probably feel more free to invent or modify categories on an ad hoc basis. We see this freedom as largely illusory, however: any category that you can define in prose can be represented by a numerical code. Moreover, unless the new ad hoc categories are explicitly defined, the substantive significance of subtle nuances in wording will probably be lost on the reader. There is even the real risk that by the time the study is published, the author will no longer remember exactly what those distinctions and nuances mean. Finally, freedom from the constraints of a fixed format may be bought at a high cost; a plethora of ad hoc and ill-defined categories provides a shaky basis for any systematic comparative analysis.

Moreover, the numerical format is probably also seen as more demanding in that it requires an *unambiguous* choice. In prose, for example, you may say that a particular problem is in some (unspecified) respects strongly malign and in other (equally unspecified) respects quite benign and then leave it up to readers to draw their own conclusions. In a fixed format we have to decide which of the existing categories provides the better fit—or define a new intermediate category that captures that particular combination of characteristics.⁸

the size of an 8-person household). Finally, continuous variables can take on any numeric value. Age, height, or tonnes of CO₂ emissions are all examples, as they can be measured down to as many decimal places we desire (within the constraints of our measurement uncertainty).

⁷ To extend a previous example, when dealing with gender as a variable, a researcher might code male=0 and female=1, but this distinction does not imply a scaled or even ordered relationship between the two categories.

⁸ [Ft. 6] In addition, researchers may have to conclude that they do not have sufficient data to determine the appropriate score. In contemplating that solution, however, they face a real dilemma. Poor data may substantially weaken any database, but so will frequent resort to the “don’t know” or “missing data” category. Researchers will have to decide in each specific case which is the lesser evil and provide the information required for readers to make up their own minds as to the implications of that choice.

Third, precisely because it can be more constraining and demanding, the numerical format will normally be more transparent. Transparency greatly facilitates criticism. For the individual scholar it may well be tempting to seek protection behind a shield of vagueness. For the research enterprise at large, however, minimizing risk is hardly a good recipe for progress. From that perspective, we concur with King, Keohane, and Verba (1994, 112) that—as a rule of thumb—it is “better to be wrong than vague.” ...

2.2 The International Regimes Database (IRD)

Probably the largest and most significant dataset on international environmental regimes is the International Regimes Database (IRD), put together over the last decade by Helmut Breitmeier, Oran Young, and Michael Zurn. With the publication of their book on the IRD (Breitmeier et al. forthcoming), they describe how the database was constructed and report some of the research that has been done so far using the database. Further, the intention of the authors is to make the database publicly available to researchers, online and in an MS Access format that would allow those who are interested to search and retrieve data.

3 INDICES

An index is a systematic framework for evaluating broad concepts or issues across large groups of actors. They are used frequently to compare countries on actions or systems that are difficult to measure directly, things such as level of development, institutional capacity, or environmental sustainability. An index is constructed from a variety of smaller pieces of data that are seen as important to the larger concept being evaluated. By assigning these specific data relative levels of importance, and then “adding up” the data for any individual country, an index score is obtained which can be used to compare countries. Indices are not really datasets in themselves, as they necessarily reflect choices that their authors made about the relative importance of various types of data, and indeed whether or not to include certain data. However, when the underlying data on which they are based is available as well, they can become a valuable gateway into datasets which relate to the larger topic. This section looks at three major indices which include information that ECE researchers may find valuable.

3.1 Environmental Sustainability Index

The Environment Sustainability Index (ESI) is part of the Environmental Measurement Project at the Yale Center for Environmental Law & Policy. According to their website,

The ESI is a composite index tracking a diverse set of socio-economic, environmental, and institutional indicators that characterize and influence environmental sustainability at the national scale. It was launched in 1999 by Professor Daniel C. Esty, Director of the Yale Center for Environmental Law and Policy, in cooperation with Columbia University's Center for International Earth Science Information Network (CIESIN), and the World Economic Forum's Global Leaders for Tomorrow Environment Task Force.

The most recent 2005 ESI report, published at the World Economic Forum's annual meeting in Davos, Switzerland, ranks 146 countries in regard to their environmental sustainability of past, current, and projected socio-economic and institutional development trajectories. The ESI has also helped to demonstrate

new conceptual hypotheses concerning the drivers of successful environmental protection.⁹

Available online at <http://www.yale.edu/esi/>, the ESI used a weighted average of 21 indicators used to produce the final ESI score. These 21 indicators, in turn, were based on 76 different variables. In addition to the main report which presents the results, the researchers have published all data for the variables in an Excel spreadsheet at the project website. The variables cover a wide range of data, from more narrow data such as air quality measures to broader topics such as environmental governance and participation in international efforts.

3.2 Human Development Report

The Human Development Report (HDR), prepared by the UN Development Programme, is an annual report that deals with global issues in human development, and includes much information on measures of development for individual countries.¹⁰ In doing so they construct several indices to evaluate countries, most notably the Human Development Index. All of the data used to construct their measures can be found at <http://hdr.undp.org/statistics/data/>, and can be downloaded by variable, by country, or all together in Excel format. Naturally many of the variables in this dataset relate far more to development than ECE (life expectancy, adult literacy, various economic metrics, etc.), but environmental data is included, particularly in measures related to immediate human well-being such as water and sanitation or public health issues.

3.3 Governance Matters Report

The World Bank has now published four of its “Governance Matters” reports, which cover six dimensions of governance for 209 countries and territories. The most recent report¹¹ includes five biennial datasets (1996, 1998, 2000, 2002, and 2004) on the six aggregate governance indicators: Voice and Accountability, Political Stability and Absence of Violence, Government Effectiveness, Regulatory Quality, Rule of Law, and Control of Corruption. The data does not directly relate to ECE, but the focus on governance may make it valuable to those looking at institutional capacity or more general questions of effectiveness. The data is available online¹² in several formats, not only standard Excel data tables, but also through webtools which can generate comparative graphs.

4 INDICATORS

Indicators are pieces of information that provide insight or evidence on issues of broader concern. They are frequently valuable as ECE metrics because of the many challenges of measuring ultimate impacts in the environmental arena.¹³ Indicators provide more easily observable evidence on the state of an environmental system, and as such are an attractive option for monitoring the performance of environmental regulation. More

⁹ <http://www.yale.edu/envirocenter/epm.htm>

¹⁰ The 2004 report is available at <http://hdr.undp.org/reports/global/2004/>

¹¹ Available at <http://www.worldbank.org/wbi/governance/pubs/govmatters4.html>

¹² <http://www.worldbank.org/wbi/governance/govdata/>

¹³ Among these challenges: the broad areas of impact for many environmental problems; the fact that changes in the environment may only be visible on long time scales; or the difficulty of establishing causality between regulation and ultimate impacts in the environment.

information can be found in the guidance document that INECE has prepared on the design and use of ECE indicators¹⁴ (INECE 2005).

4.1 OECD Environmental Indicators

The OECD Environment Directorate collects and publishes environmental data and indicators for member countries.¹⁵ They publish certain key environmental indicators online for free.¹⁶ However, their more comprehensive compendium of environmental data and indicators¹⁷ must be paid for, either by purchase or subscription. Once purchased the compendium provides access to web pages where the data is available in Excel format.

4.2 INECE/UNEP Indicators Project

INECE is currently working on a pilot project with the United Nations Environment Programme (UNEP) to develop indicators to measure the effectiveness of implementation of biodiversity MEAs. INECE and UNEP are working with four countries—Brazil, Costa Rica, Kenya, and South Africa—to develop indicators that will assist the countries in assessing their implementation of biodiversity MEAs, with a view to helping countries carry out implementation activities more effectively and efficiently by identifying synergies between treaties. This project will initially focus on input indicators (commitments such as staff or funding) and output indicators (activities such as inspections performed or enforcement cases issued). The long-term goal is to develop intermediate outcome indicators which will measure progress toward a final outcome, such as changes in behavior on the ground.

The INECE website also has a forum on indicators¹⁸ that has links to key publications on indicators, some of the environmental indicators projects, and other news and resources on indicators.

5 SURVEYS

One of the valuable sources of information on the behavior of individual firms and their implementation of and compliance with environmental regulations comes from surveys. While survey responses are a type of self-reported data, and hence there may be questions of accuracy or reliability for the information from any one specific firm, taken as a whole they still represent a valuable source of information about what firms are generally going. Surveys can also collect valuable data that move beyond strict regulatory compliance and into questions of environmental management practices or systems that have been voluntarily adopted.

5.1 OECD Environment Directorate survey

In the spring of 2003 the Empirical Policy Analysis Unit of the OECD Environment Directorate coordinated an effort to survey more than 4,000 manufacturing firms in Canada, the United States, France, Germany, Norway, Hungary, and Japan. Companies were surveyed on their environmental management practices, on the technical measures that been adopted to address environmental impacts, and on the

¹⁴ Available at http://www.inece.org/conference/7/vol1/06_Workshop1A_Stahl.pdf

¹⁵ http://www.oecd.org/department/0,2688,en_2649_34441_1_1_1_1_1,00.html

¹⁶ The 2004 report can be downloaded at <http://www.oecd.org/dataoecd/32/20/31558547.pdf>

¹⁷ This is updated every two years; the current version is the OECD Environmental Data Compendium 2004.

See http://www.oecd.org/document/58/0,2340,en_2649_34441_34747770_1_1_1_1,00.html

¹⁸ <http://www.inece.org/forumsindicators.html>

stakeholders or motivations that influenced environmental policy and practice at the firm.¹⁹ Researchers used the collected data to conduct formal econometric analyses on questions related to the determinants of environmental management and performance in firms, and the links between public environmental policy and corporate behavior. The survey and research results were presented at the OECD Conference on “Public Environmental Policy and the Private Firm,” held in Washington D.C. on June 14-15, 2005. (Johnstone et al. 2005(6), overview of the data; studies in Johnstone et al. 2005(8) and Henriques et al. 2005) It is unclear whether the OECD intends to publish the database or make it available to other researchers. Nick Johnstone at the OECD Environment Directorate Empirical Policy Analysis Unit is the Project Leader for the study and could be contacted for further information.

5.2 SME-environment

In 2003 UK Environment Agency commissioned a study of more than 8,000 small and medium enterprises²⁰ (SMEs). The survey was undertaken for NetRegs, a web resource of the Environment Agency that provides information and guidance to SMEs on environmental legislation that affects them.²¹ The survey divided firms into categories of micro (<10 employees), small (10-50) and medium (50-250) and asked them about their use of environmental management systems, their implementation of practical environmental measures, their awareness of applicable legislation, and sources of guidance or influence for firms. Unfortunately, the survey data has not been made available through their website.²²

5.3 Environmental Management Practices

Researchers at the University of California, Santa Barbara,²³ surveyed more than 500 U.S. companies from several sectors in 2003.²⁴ The focus was on heavily polluting industrial sectors, based on their share of emissions in the Toxics Release Inventory (TRI). The survey was targeted towards facility environmental managers. Its goal was to assess how environmental management practices (EMPs) impacted the environmental and corporate performance of the surveyed firms. It also examined how EMPs came to be adopted, looking at the perceived external forces acting on the firm (e.g., regulation, market pressure, or public pressure from environmental groups). The researchers have published some of their results and analysis (Delmas and Toffel 2005), although currently the available data is in summary, rather than detailed, form.²⁵

6 STATISTICS

While indices and indicators may serve as useful datasets when looking at broader trends, and surveys may allow researchers to tailor their questions, many researchers will need specific factual data on their topic of interest. The entire range of factual datasets is far too large a field to cover in this paper, and so the goal of the section below is to highlight representative examples. In general the flow is from broader, more

¹⁹ In addition, firms were surveyed for their “demographics:” firm size, industry type, facility characteristics, etc.

²⁰ Defined for the study as firms with fewer than 250 employees.

²¹ A summary of the survey results can be downloaded at: http://www.environment-agency.gov.uk/commondata/acrobat/smenvironment_uk_2003.pdf

²² <http://www.netregs.gov.uk/netregs/>

²³ Principal investigators were Dennis Aigner and Magali Delmas.

²⁴ A description of the survey can be found at: <http://www2.bren.ucsb.edu/~delmas/survey>

²⁵ This can be found at: <http://fiesta.bren.ucsb.edu/~delmas/webpage/Papers/Delmas-Toffel-WP.pdf>

general information that may be global or regional towards more specific information that may concern only a specific industry or set of firms.

6.1 EarthTrends

EarthTrends is produced by World Resources Institute (WRI). It is a large online database²⁶ that contains country-specific information across ten environmental issue areas. While the database as a whole is not specifically focused on compliance and enforcement, many of the specific datasets could be useful to ECE researchers, particularly related to international environmental agreements. The database can be searched by country or by variable, and data tables can be downloaded in a common filetype (.csv). WRI assembles this information from a wide range of sources, and these are linked from the EarthTrends website, so the database can also serve as a portal to a variety of other information sources. To use EarthTrends users must register their email address on the website; registration is free.

6.2 The Toxic Release Inventory

The Toxic Release Inventory (TRI) in the United States is an example of the type of data that can be generated by mandatory disclosure laws. The TRI contains data on the discharges of a wide range of hazardous materials, and is available to the public at the EPA website.²⁷ Datasets such as the TRI may not necessarily relate to direct compliance, in the sense that information disclosure mechanisms can cover activities for which there are no regulatory requirements, other than disclosure itself.²⁸ Further, these datasets may face questions of reliability or legitimacy if they consist of self-reported data, as the TRI does. Despite this, mandatory disclosure laws can generate datasets on the behaviors of firms which may be useful to the ECE researcher.²⁹

6.3 Emissions Inventories

The last decade has seen a rise in the number of market-based programs that are used in environmental governance, and particularly the use of emission trading systems. In order for the emission markets to function, a significant quantity of information must be centrally maintained: the allocations of emissions allowances, the actual emissions of participants, and the transfer of allowances between firms. Besides being available to participants, these databases are also frequently publicly accessible, as in the two examples here.

6.3.1 U.S. Acid Rain Program

In the United States the Acid Rain Program³⁰ was established to reduce emissions of sulfur dioxide (SO₂) and nitrous oxides (NO_x). The emissions data for these two pollutants, and for carbon dioxide (CO₂), is made publicly available through the US EPA website,³¹ where hourly data can be downloaded by quarter from 1995-present.

6.3.2 EU Emissions Trading Scheme

²⁶ <http://earthtrends.wri.org/>

²⁷ <http://www.epa.gov/tri/>

²⁸ The analogous situation with the TRI would be disclosure of chemical releases for which a firm has no permitted limits or regulatory requirements. The only regulatory requirement is that the firm report the amount of chemical released.

²⁹ Not least for those interested in the effect of information disclosure on environmental performance.

³⁰ <http://www.epa.gov/airmarkets/arp/>

³¹ Overview of data: <http://www.epa.gov/airmarkets/emissions/index.html> Download quarterly data: <http://www.epa.gov/airmarkets/emissions/raw/index.html>

The European Union's Emissions Trading Scheme (EU ETS) covers the greenhouse gas emissions of approximately 12,000 installations across the EU.³² The system began operation early this year. Eventually all member states will have registries which will be accessible online,³³ although to this point most countries are still working to get their registries up. Once fully operational the EU ETS website will also allow searches on transactions and accounts.³⁴

6.4 Environmental Working Group Farm Subsidy Database

The Environmental Working Group's (EWG) Farm Subsidy Database is one of the more innovative examples of how publicly accessible information can be used to raise environmental awareness. EWG publishes the Farm Subsidy Database on their website,³⁵ collecting the information on payment of subsidies from publicly available information published by the USDA. The database currently covers nine years, 1995-2003, and has influenced the debate on farm subsidies and land conservation.

7 CONCLUSION

The goal of this paper was to introduce ECE datasets to those who are unfamiliar with them and also to begin a central list of resources that will be valuable to researchers. In this current paper the authors did not attempt to create an exhaustive list of ECE datasets; effort was focused rather on including all of the major types of information the ECE researcher is likely to use, and then finding representative examples of these types.³⁶ However, the authors hope that this will be the start of a kind of master list of datasets available to those interested in studying ECE. As is apparent from the paper, many of these resources are available online, and ultimately that is where some version of this list would be most useful, where it could serve as a portal to environmental data.³⁷

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³² <http://europa.eu.int/comm/environment/ets/>

³³ Centrally listed at <http://europa.eu.int/comm/environment/ets/registrySearch.do>

³⁴ <http://europa.eu.int/comm/environment/ets/transaction.do>

³⁵ <http://www.ewg.org/farm/>

³⁶ For these representative examples the choice was usually to include the most widely used or well known datasets.

³⁷ Some versions of this already exist, typically in a more narrowly focused format, so the question may be whether to create a master list of resources, or merely link to other pages if they already sufficiently cover a category of ECE datasets. For example, Ron Mitchell, a professor at the University of Oregon, has a webpage devoted to environmental data sources (<http://www.uoregon.edu/~rmitchel/data.html>) that thoroughly covers international environmental politics.

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