Philosophical and Methodological Issues in Understanding Transportation Impacts: Learning from other Disciplines

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Abstract

It is the premise of this paper that many disciplines, within the social sciences and outside of them, look at exactly these sorts of compound questions; that it is possible and useful to look how various disciplines identify and phrase such questions and also to look at the various methods that are employed to gain answers to them; that knowledge gained from other disciplines in these respects can then be applied to improve public policy analysis; and that new methods, or more likely and more properly speaking, hybrids of existing methods, or research protocols derived from them, can then be developed for actual use by public policy analysts. This paper will take a preliminary stab at developing these premises in a concrete fashion. First some philosophical issues surrounding “social science” inquiry will be discussed. Then, using the particular case of forensic entomology (the use of insect science to solve crimes), a stylized investigate protocol is developed and then applied to a simple case of the urban economic development impacts of highway investments to see how seemingly unrelated disciplines might inform each other in setting up and examining specific problems. Finally, an agenda for further research is then discussed.

Key words: methodology; transportation; interdisciplinary research; evaluation; social science research; empirical analysis; economics; epistemology.
Introduction

There are any number of ‘big’ questions in the field of transport and the economy. Some key examples include:

- How do highway investments affect growth and development of urban economies?
- What factors determine modal choice and what sorts of public policies affect those factors and the corresponding choices?
- How should transportation policy respond to changing trends in corporate logistics arrangements?

Three things stand out about these particular questions (and there are many more like them, these being examples of a particular type). (1) They are queries about transportation impacts and activities. (2) They are also compound questions, with a “why” which asks about the nature of things in general, and a “what” which asks for specific details about what to do in particular situations. (3) They all have been the subject of much debate and study and yet despite all that often lack compelling answers.

Why can it be so hard to gain any sort of consensus on questions such as these? It is the premise of this paper that many disciplines, inside and outside the social sciences, look at exactly these sorts of compound questions; that it is possible and useful to look how various disciplines identify and phrase such questions and also to look at the various methods that are employed to gain answers to them; that knowledge gained from other disciplines in these respects can then be applied to improve public policy analysis; and that new methods, or more likely and more properly speaking, hybrids of existing methods, or research protocols derived from them, can then be developed for actual use by public policy analysts.

This paper will take a preliminary attempt at developing these in a concrete fashion. First some philosophical issues surrounding “social science” inquiry will be discussed. Then, using a particular case of forensic entomology (the use of insect science to solve crimes), a stylised investigative protocol is developed and then applied to a simple case of the urban economic development impacts of highway investments to see how seemingly unrelated disciplines might inform each other in setting up and examining specific problems. Finally, an agenda for further research is then discussed.

Philosophies of Investigation into Social Phenomena

The study of transportation is, in a very broad sense, an example of a social inquiry. There are physical facilities and phenomena involved, but in the end the main concern is with the movement of goods and people for very specific individual and social ends. In this sense, though very much interdisciplinary in its questions and approaches (out of necessity since it is a very complex issue), transportation is a classic “social science” discipline.

Conventional wisdom has it that social science deals with “soft” issues, difficult to define, measure and understand. Because of this “softness”, agreement on basic facts is difficult to come by and proof of various contentions is nearly impossible. To put it all philosophically, both the physics and metaphysics of social science is especially hard for human beings to pierce (Kline 1980).

The straw-man contrast to social science are “hard sciences” such as physics and chemistry, or “pure” logical analysis, especially that of mathematics. Also included in this contrast are applied sub-fields of these disciplines such as the various types of engineering (e.g. mechanical, civil etc.). In these areas there is plenty of controversy, especially with regard to “why” questions, but there seems to be more basic agreements about facts in general and “what works” in particular situations. Thus physics no longer has the comfortable consensus of Newtonian mechanics to rest upon, but the Newtonian model seems to work well enough even though it is now “known” that it is not literally “true”, even on earth particularly at the subatomic level and superficially at least there appears to be more consensus on epistemology among physicists than among, say, political scientists (Hawking 1988).
Though somewhat outside the conventional framework, there seems to be a set of “in-between” disciplines which are heavily applied and less theoretical but which nonetheless must consider “why” questions along with “what” questions. This category includes law, history, anthropology, and archeology. Fields such as these are characterized by heavy field work of various sorts, and this is often the jumping-off point for most analysis, i.e., collect data first and then see what emerges. Fields such as these have always had a theoretical component and in many ways are getting more theoretical, but there is a certain certitude which comes from their grounding in observation and reporting (much like good police work) (Fogel & Elton, 1983).

This typology is, like all typologies, quite imperfect. Biology, a natural science, might be said in practice to be more like an “in-between” field than a “hard” science, and many consider it to be the softest of the hard sciences, especially when studying human and other ecologies for example. But it serves the purpose of organizing concepts for the consideration of methods of inquiry.

**Method and Approach**

Of course the characterisation above, while conventional, is incomplete. There are many schools of thought, often at odds with each other, that would question how “hard” hard sciences really are; some examples are to be found in the sociological and postmodern schools of science which hold that any human search for knowledge is bound to be as frail as the human beings conducting the search — hence physics is really much more about what is in a self-interested and culture-bound person’s mind than about what is really out there, more a play of language and narrative than of reality (Foucault 1971; Roe 1994).

More philosophical inquiries take a cue from Heisenberg and Godel, to say nothing of Einstein, to argue that logic, even good logic, is always incomplete and hence all systems based on it are incomplete. Morris Kline has argued this point forcefully in the case of pure mathematics (Kline, 1977). All of which is to say that there are compelling arguments out there for questioning the premise that social science is always going to be harder to do than other types of analysis.

The fact that fundamental epistemological distinctions between disciplines are now fuzzier calls into question related distinctions that are made between different disciplines as to how they approach “why” and “what” questions. Interestingly, much energy has been spent on showing how “soft” hard science is rather than how “hard” soft science may really be. The intent here is to argue that whatever the discipline, human beings have certain ways of going about finding out things and that these ways can cross-fertilise much more than they do currently.

Questions of method invariably get into philosophy, but this paper is very practical in trying to break down different types of inquiry into some component parts and then bring what is done in one discipline to bear on another. The focus is to inform public transportation analysis, but cross-pollination in other directions, from policy to “harder” fields, is not out of the question. Indeed, in many ways, transportation analysis has become more and more sophisticated in its methods. There may perhaps be too much of a bias towards quantitative and abstract analytical approaches at the expense of more concrete and qualitative discourse, but there may be something that a transportation analyst can teach a physicist. Nothing is ruled out here.

**Component Parts of Analysis**

Any inquiry in any field could be said to made up of at least these components (Hanson, 1958; Lincoln & Guba, 1985; Creswell, 1994):

- Problem identification/definition
- Question formulation
- Observation
- Pattern recognition
- Reasoning
• Generalization
• Explanation (cause and effect)
• Reporting
• Replication/verification

It almost goes without saying that these component parts do not go in any particular order. Reasoning and generalization can and often does precede and guide subsequent observation for example. My argument is that one can usefully scan practices in various fields, break down and classify their methods into these component parts, and then determine whether a useful transfer of methodological technology might be affected. If it can be, then such a transfer, in the form of concrete application, can be attempted.

An Example: Forensic Entomology and the Urban Economic Development Impacts of Highway Investments

Here, in a very preliminary form, is how the “deconstruction” of method might proceed and how it might be then brought to bear on a public policy case, in this instance the economic development impacts of infrastructure. This example will also serve to flesh out some of the meaning of the concepts introduced above (Ruderman 1997).

Observation: A husband and wife and their 13-year old son are found shot and killed in their apartment. Blowfly larvae present in bodies. Larvae have stopped feeding.

Question formulation: Any number of possible questions — who did the shooting, where did it occur (i.e. were the bodies brought there from somewhere else after shooting) etc.? Question to focus on for purposes of this illustration: When did the shooting occur?

Problem identification/definition: Determine time of death as way of finding the killer or killers; sub-tasks then identified at that point — question people who were at scene at time of death, track movements of victims at that time, etc.

Pattern recognition: Knowledge — gained from other observations outside this particular case — that blowfly larvae of this type which have stopped feeding are usually 8 to 12 days old.

Reasoning: Shootings must have occurred 8 to 12 days ago.

Generalization: Presence of blowfly larvae which have stopped feeding which are found on human bodies indicate that bodies have been present for at least 8 to 12 days.

Explanation (cause and effect): Blowflies are attracted to the odour of human flesh decaying from hundreds of yards away. Blowflies were in the vicinity when the killing occurred. Blowflies migrated to the body immediately after the killing. Therefore, the killing took place 8 to 12 days ago.

Reporting: Standard criminal laboratory protocol.

Replication/verification: In the actual event, location and conviction of actual killer and reconstruction of time-frame of death based on collected facts. Of method itself, comparison of explanations generated by forensic procedure and actual case solutions (Ruderman, 1997; Puerini, 2005; Amendt et al, 2007).

In a very rudimentary way, a research protocol has been developed from a specific application from the field of forensic entomology. This protocol could then be further fleshed out and deepened by examining other examples from the field. By looking at these other cases, and at examples from other fields as well, the framework offered above might be modified, and/or various alternative frameworks could be developed; it would not be surprising that there might be more than one approach.

Now to shift to a rudimentary application of the schema above to the example of infrastructure and economic development to see if it has any use in that particular area.
First a brief review of what is believed to be known about the role of transport infrastructure in the economy. There is agreement that the services provided by infrastructure, broadly defined to include all types of public works, does have a positive affect on measured output. Thus, whatever representation of output is being studied - national output, gross state product, manufacturing output, personal income, manufacturing value-added, total factor productivity (TFP) - most studies have found that more public capital is associated with higher levels of that output. Empirical results also generally indicate that infrastructure's positive impact on production is greatest at the national level, and lower as the level of analysis gets smaller (e.g. from nation to region to state to city) (Boarnet 1998; McGuire, 1992; Eberts, 1991).

There is, however, no consensus on the extent to which infrastructure is a cause or an effect of economic growth. While economists accept the notion that, on average, where there is more infrastructure, there is generally more economic activity, there is not yet a consensus on what circumstances lead to infrastructure investment being a cause or an effect of economic activity (i.e. about whether public works generally leads or follow economic growth). There are also only some theoretical propositions on how infrastructure affects the economy, rather than any firm or empirically proven understanding (Eberts, 1991).

So regarding the issue of understanding the causality or transport infrastructure on the workings of the economy, the forensic entomology discipline may provide some guidance on how to proceed analytically in a way that might not be occurring to current practitioners. Here is a sketch of how that might work.

Subsequently, the protocol itself has to be analysed. A quick scan indicates that forensic entomology uses the presence of physical evidence from living insects to commence a logic chain which connects this physical evidence to an estimate of a time of an event, in this particular case, the time of death of a murder victim. This logic chain rests upon knowledge of the structure of the life-cycle of various types of insects to make certain key inferences. Since infrastructure and economic development impacts have a large physical component, this protocol might have some value in this case, if not for actual application, to at least indicate what an analyst might need to know to use it. A rough filling in the categories might go like so:

**Observation:** Physical condition of surface streets in New York City are deteriorating. Job formation in the City is below national average. (Note: these may not be precisely actual fact — offered for illustration only)

**Question formulation:** How does physical condition of surface streets affect the New York City economy? More specifically what sorts of physical economic manifestations might be linked to it? This might require further observation of such manifestations. One thing that the entomology protocol suggests is that like be connected with like: if we are using physical evidence, we might first look at other purely physical evidence which might be associated with it, or perhaps only look at such evidence, excluding non-physical evidence from consideration.

**Problem identification/definition:** Following the entomological model, an appropriate problem to focus on might be to link the condition of roads with the timing of various economic events such as specific private investments in physical structures such as buildings.

**Pattern recognition:** Forensic entomology uses a knowledge of basic structure of insects to draw conclusions. An initial query: is there some basic analogous structure of knowledge for infrastructure? Perhaps physical models of travel speeds and road condition could be a starting point.

**Reasoning:** Deteriorating road condition in New York City accounts for below national average job creation. What sorts of statements are necessary to support this statement and what sorts of evidence are available to back it up?

**Generalization:** Roads must be kept in good condition to maintain healthy job growth. The forensic entomology model would again point to the need for some sort of basic structural knowledge based on multiple cases to make such a generalization.
Explanation (cause and effect): Poor roads increase travel times. Increased travel times increase costs of doing business. Increased cost of doing business reduces frequency of new business formation and increases time it takes for new businesses to form. Reduced numbers of new businesses reduce numbers of new jobs formed. This is one of many possible scenarios. Would increased structural knowledge reduce the number of possible scenarios? How could this structural knowledge be obtained or built up where it is lacking?

Reporting: Is there anything that a forensic report could teach analysts of economic development in terms of presenting useful information?

Replication/verification: Are there analogues of successfully concluded criminal cases in the economic development field pertaining to road condition that can be used as verification of hypotheses and replication of results?

Conclusion and Discussion

The development and application back and forth of research protocols is something that can be very useful. Ultimately it would be fruitful to have an examination of a wide range of fields, disciplines and approaches to compare, contrast and collect the ways in which phenomena are examined and understood.

The ideal and “simplest” starting point is likely between fields with very specific focuses and intents which could then be transported (if the pun can be excused) to transportation analysis with similar intents and focuses. Forensic entomology, which seeks to fix the times of specific events using common knowledge of insect biology and behaviour, has been offered as a discipline that might offer protocols useful for analysis of transportation and economic development, where the timing of equally specific events (such as job formation and highway building) might be fixed and understood through use of common knowledge of travel behaviour.

However, let’s be even bolder just a bit. Nonscientific fields may also be of value. For example, since transportation facilities need to be designed as well as built, perhaps disciplines allied with such design, such as art and architecture, and knowledge of human response to aesthetics, might be of use in understanding transportation activities and impacts. It may also prove useful to look at historical applications of methods in various fields, and also to look at fields which are not only nonscientific but nontraditional as well.

Political investigations might be of use as an example of a particular method of examining and reporting on social phenomena. Audubon and other nature studies of the period might have something to say about typology and observation. Methods of cartography as way of classifying and dissecting phenomena may be of interest. Buddhist and other Eastern systems of knowledge, e.g. Tibetan physiology, may have something to say about current methods.

Finally, there may be interesting interactions and dialogues to be had between formal research and planning protocols from one field to another. To return to the transportation field, strategic planning templates using scenario simulation and comparison might be able to inform fields both within and outside the ‘social sciences’ (Zegras et. al. 2004).

Although preliminary, such talk is not mere flight of fancy. The general point is that research protocols used in other disciplines offer a rich mine for enhancing methods of investigation of transportation phenomena.
References


