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Using Natural Experiments in Public Enterprise Management

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Abstract

Research in public enterprise management is becoming increasingly quantitative and scholars are aspiring to achieve the same standards of academic excellence that hard disciplines demand. Researchers in the domains of Public Economics, Public Finance, Human Resource, Marketing and Industrial Organisation, among others, are trying to mimic the principles of Physics by building complex mathematical models and conducting experiments. Since the scope for field experiments management is limited, scholars of these disciplines are increasingly employing natural experiments for research that aims to explore causal relationships in observational studies. Natural experiments are means to overcome some of the obstacles that researchers face while making causal inferences. To compare the actual with counterfactual, the difference-in difference methodology has seen many advances in recent years. However, mimicking research in Physics comes at a cost. Public enterprises due to their social responsibility deal with situations that have significantly more uncertainty than what Physics addresses. With some care, natural experiments can enhance research in management of public enterprises as also inform public policy.

KEYWORDS: Natural Experiment, Difference-in-Difference, Mathematisation, Internal validity, External validity

Introduction

Quantitative research in management is a new phenomenon. Not long ago PhD in management was non-existent and management research would have been considered an oxymoron. Till the 1960's, teaching management comprised of educating the ignoramus and producing "ideal managers" which was sought to be achieved by emulating other good managers. Top-tier universities did not accord management education the status they accorded to law,

engineering or medical education. MIT conveniently utilised the services of the manager of the nearby General Motors assembly plant for teaching (Bennis, & O'Toole, 2005). There were few full time teachers and research was, of course, irrelevant in a setting that hardly provided a comprehensive and professional education. It was not realised that in the decades ahead managers would need a higher order of analytical ability, a more sophisticated command of analytical tools, a greater degree of organisational skill, a greater capacity to deal with the external environment and an enhanced ability to cope with rapid changes. While no one doubted that for most people a strong vocational training, which equips the person to do a first job situation with modest intellectual demand, is essential it was becoming clear to many academics that this was not the job of the management school (Nelson, 1961). This issue also attracted the attention of general purpose philanthropic foundations in the United States where former academics and staff members with strong academic credentials constituted a major contingent in foundation leadership. The result was the publication of the Ford Foundation (Gordon & Howell, 1959) and the Carnegie Foundation (Pierson, 1959) reports. Both reports criticised management courses as being overly descriptive and lacking in serious analysis. Lack of theoretical research, non-intellectual curriculum and teachers with unclear mission were major criticisms in both of these influential "Foundation reports". The US press, especially the *New York Times,* provided extensive coverage to these reports forcing management schools to have serious look at the existing educational system.

Since most content in these reports was based on studies conducted by the management schools themselves, it was impossible for these institutions to ignore the reports or respond to the accusations without appearing to be self-serving and defensive. In the event, the management schools decided to transform themselves into academic institutions of substance. Management came to be seen not merely as a profession but as an important academic discipline as well all over the world. Good management schools now profess a dual mission: to educate practitioners; and, to create knowledge through research. The emphasis is on the latter because the frontiers of research are expanding and increasingly grounded in academic rigour. Few, if any of today's top-ranked management schools, would hire a tenure-track professor whose primary qualification is managing an enterprise with distinction or is reputed to teach well. Nor would they hire a person who has not demonstrated the potential to publish in top academic journals. These publications are usually not directly relevant in the classroom or workplace (Babin et al., 2021). However, accumulation of tiny facts through ongoing research accrete to a larger and more general scientific

understanding of organisational behaviour and the environment in which the enterprises function. Management research impacts the pace of advancement of knowledge in management which in turn impacts innovation and the competitiveness of enterprises (AACSB International, 2012). Adoption of this "scientific model" or "research based model" as it has come to be known, has raised the standing of the management schools within the university vis-à-vis other schools. Instead of merely offering high quality teaching, top management schools offer high level of scholarship through research supported learning process and their mission statements aspire to create ideas that deepen and advance our understanding of management.

Intergovernmental organisations promoting enterprises, like ICPE not only train public sector managers, they seek to facilitate societal advance by supporting research that pushes back the boundaries of knowledge. One consequence of this rigorous scholarship is the increasing importance accorded to the quantitative side of management research. It then follows that not only has Economics become more mathematically oriented but the study of other disciplines has been transformed as well. For example in the field for marketing, intuition and judgement are increasingly being replaced by the probability theory and operations research models. Globally, the emergence of rigorous empirical management research has led to welcome changes in the attitudes and practices of working managers (Williams, 2010). The management scholars now aspire to achieve the same standards of academic excellence that hard disciplines demand.

Some scholars feel that the management schools in their quest for legitimacy and identity have gone too far (Schermerhorn Jr et al., 2020). Top management schools have a number of professors whose only practical experience of management is managing their own research budget and assistants. The trustees and deans of these schools have begun to question the relevance of the costly and lengthy research being conducted and the utility of hiring of costly and unproductive faculty members seeking tenure (Krugman, 1995). Another effort towards mimicking Physics is the quest for experimentation. Undergraduate students present themselves as an unlimited supply of guinea pigs. Management researchers, especially in the fields of Economics and Finance build models of financial markets and other economic systems that are as predictive as models of physical sciences, thus creating a false sense of mathematical precision. While experimental economics and experimental finance have not been able to gain much respect or popularity, scholars in Economics as also other social sciences are increasingly turning towards what have

come to be called natural experiments which are observational studies that can help determine causality.

Mathematisation

Under the hierarchical system, while the quest for Physics in Biology distorts so much of the philosophical thinking about biology (Dennet, 1995), the economists not only try to model their discipline on Physics but try to mimic epidemiology as well by borrowing medical terms like contagion, Dutch disease and liquidity injection to lend their work an air of scientific rigour (Debrue, 1991). There is a yearning to be like Physics which appears to be precise, self-contained, logical, and mathematical. For management scholars, it is the place to be in.

Theoretical Physics is the inaccessible ideal towards which economic theory strives and this striving is a powerful stimulus in the mathematisation of economic theory. While explaining the general principle of comparative static analysis, Paul Samuelson (1947) pointed out that this is essentially the method of thermodynamics. Samuelson (1998) went on to explain that Economics and Physics could share the same formal mathematical theorems, viz., Euler's theorem on homogeneous functions, Weierstrass's theorems on constrained maxima, Jacobi determinant identities underlying Le Chatelier reactions and so on. Mathematisation of Economics led to a series of breakthroughs. The emergence of Econometrics ensured that theory continued to guide empirical research as it does in physical sciences. Option pricing formula used in Financial Management is also the solution to the heat equation (Osu & Egbe, 2016).

Quest for experimentation

Experimentation has been most widely used in the natural sciences leading to spectacular advances in knowledge. An experiment is the deliberate intervention by an investigator in a situation so as to be able to draw inferences about the relationships under study. Experimentation has been found to be much less successful in the social sciences. The main reason for relative sterility of experiments in the area of social research is the unbridgeable gap between the behaviour of elements of nature like electrons and that of human beings. As the Physicist Richard Feynman was fond of saying: "Imagine how much harder Physics would be if electrons had feelings". It is very difficult to persuade human subjects that they are not part of an experiment. The particles of Physics do not choose to behave as they do whereas human behaviour has volition (Heilbroner, 1999). Field experiments also lend themselves to criticism because some people or areas may get

a favourable treatment for no valid reason and also because that people dislike their lives being used as a laboratory.

Social scientists are now turning towards natural experiments. In these experiments (sometimes called quasi-experiments) randomisation is done not by the researcher but occurs through an unanticipated natural event. This method can be traced back to the work of John Snow (1855) in Public Health. According to the miasmic theory of cholera prevalent the time, it was believed that cholera was caused by bad air and methods such as digging up and removing carcasses of horses were tried to control cholera. To prove that cholera is caused by bad water rather than bad air, Snow compared the changes in cholera mortality rates in the districts served by two water utilities which in 1849 sourced their water supply from the river Thames in central London. In1852, one of the companies moved its water works upriver to an area relatively free of sewage. Cholera mortality reduced in both areas in 1853 but much more so in the areas supplied by the utility whose water works had moved upriver. With the exception of some occasional published and unpublished articles, natural experiments did not attract much attention in the management literature until the 1990s. Since then, a large number of studies have come out in diverse disciplines and researchers have used this approach to improve causal inference in a wide variety of fields, including Accounting and Corporate Law (Venkataraman et al., 2004), Corporate Social Responsibility (Wang et al., 2011), Entrepreneurship (Rostam-Afschar, 2010), Human Resources (Meyer et al., 1995), Innovation (Lin, 1995) and Strategy (Younge et al., 2015). By now, the methodology has been more or less standardised though finer points continue to be debated.

Through a natural experiment researchers attempt to find a naturally occurring comparison group that can mimic the properties of a control group in a physical experiment. A natural experiment is analysed through Difference-in-Difference (DD) method to reveal the average change caused by the 'treatment'. DD estimates are derived by using Ordinary Least Squares (OLS) in panel data for several periods of time before and after an intervention. Let Y_{ist} be the outcome of interest for individual i in group s by time t and I_{ist} be a dummy for whether the intervention has affected the group s by time t. The following regression is estimated:

$$Y_{ist} = A_s + B_t + \mathrm{c}X_{ist} + \beta I_{ist} + \varepsilon_{ist} \qquad (1)$$

where A_s and B_t are fixed effects for groups and time periods respectively, X_{ist} are relevant

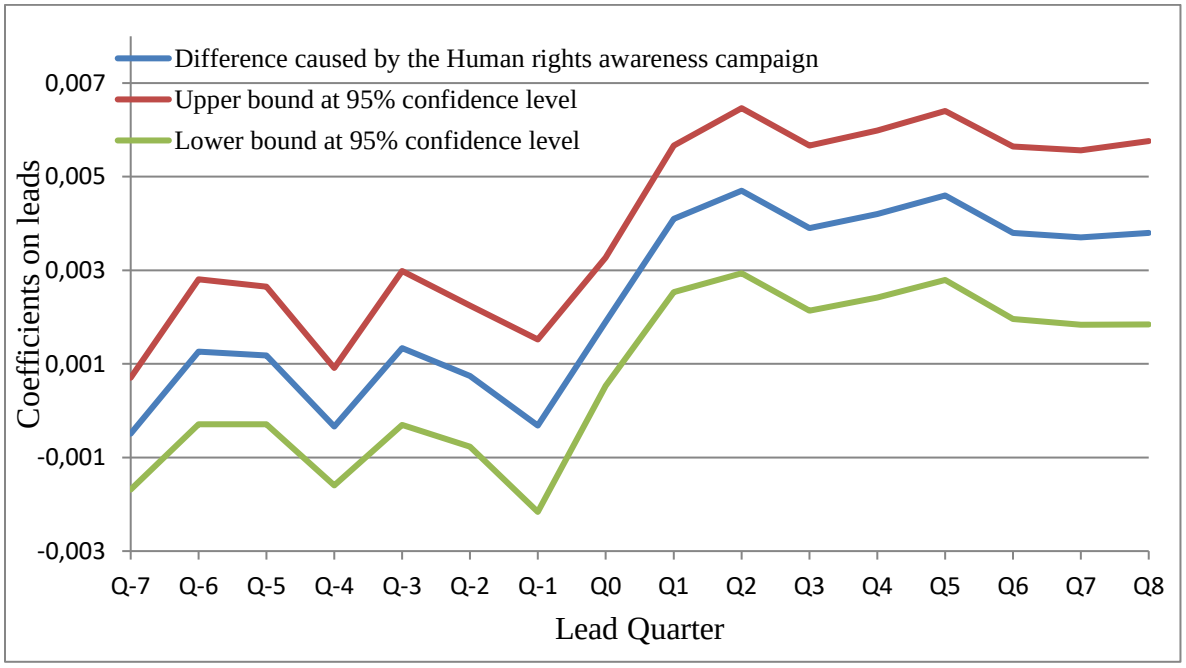
individual controls and ε_{ist} is an error term. The estimated impact of the intervention is then the OLS estimate of β.

DD can not only estimate the average effect of the intervention but also reveal whether the effects persist over time. To assess impact of human rights awareness on entrepreneurship, Figure 1 plots the coefficients of the following regression:

$$Y_{ist} = A_s + B_t + \Sigma\delta_l Q_{li} + \varepsilon_{ist} \quad (2)$$

where Q_l is a set of dummy variables for lag and lead quarters relative to the time of implementation in a given district. The plot reveals that the awareness of human rights promotes entrepreneurship and the effect of human rights awareness campaign are not temporary blips but last over a period of time.

Figure1. Impact of Human rights awareness on entrepreneurship over time.



DD design has several extensions including DDD which can, for example assess the impact on, say, two different types of potential entrepreneurs. A 'discontinuity design' is an extension of natural experiment that exploits situations where probability of enrolment into treatment changes discontinuously with some continuous variable (Blundell & Costa Dias, 2009).

Natural, experiment or neither?

Natural experiments exploit an event that happens to affect some subjects and not others. The researcher assumes that the naturally occurring intervention was assigned as if it was random (Dunning, 2008). There is a continuum of plausibility for natural experiments, defined by the

extent to which 'treatment' assignment is 'as if' random. This raises major concerns relating to internal validity. First there is the issue of the possibility of endogeneity of the interventions (Besley & Case, 2000). Some authors go to great lengths to prove exogeneity but in many papers the issue is dealt with cursorily. There are concerns about the appropriateness of the control group and linearity assumption in DD estimation. Ongoing research in Econometrics is identifying problems as also solving some of the same. For example, methods are now available to minimise the problem of serial correlation (Bertrand et al., 2004) which was not tackled in older studies showing the findings statistically significant when actually they were not. No natural experiment can claim the internal validity of a Physics laboratory experiment. When management research was in its infancy, it was criticised for not being as rigorous as research in physical sciences (Lorie & Roberts, 1950). Now, researchers in management using fancy mathematics are criticised for assuming certainty and predictability of Physics. In the field of Industrial Organisation, models are sensitive to simplifying assumptions about consumer preferences, asymmetric information and the ability of firms to make strategic commitments. Nobel laureate econometrician James Heckman (2000) doubts whether DD estimator can ever isolate a specific behavioural parameter.

External validity concerns inferences about the extent to which a causal relationship holds over variations in persons, settings, treatments, and outcomes. For a Natural Experiment to produce "useful knowledge" beyond its local context, it must illustrate some general tendency, some effect that is the result of mechanism that is likely to apply more broadly. Unfortunately, results cannot automatically be extrapolated outside the context in which they were obtained. It is well known that there are significant differences between human resource management practices of private and public sectors. Several studies are available from the point of view of private sector management, but scarcely any from the perspective of public ector. There is also the problem of scaling up which does not usually occur in physical sciences. In case of public enterprises, what is observed in small groups may not be relevant in large groups. Yet, many studies that tightly monitor internal validity employ much looser arguments to defend the transplantation of the experimental results to policy. The obvious answer to this problem is replication studies. Apart from the cost, replication studies have the problem of respectability. No academic journal of repute is likely to publish a replication study and therefore in a 'publish or perish' no prudent academic will be enthused to take on replication studies which cumulatively can claim external validity. While the use of natural experiments for establishing causality is becoming more sophisticated and probably more reliable,

the problems of internal validity and external validity still remain (Leamer, 2010). Public enterprises need to finance replication studies.

Conclusion

Management of public enterprises is different from private sector management for a vairety of reasons (Boye, 2022). Public enterprises face a variety of stakeholders, each of whom places demands and constraints on managers, e.g., taxpayers and service recipients, consumer groups and producer groups (Metcalfe, 1993). Public organisations are "open systems" that are easily influenced by external events. It is the responsibility of public managers to protect and promote this permeability of organisational boundaries in order to ensure that services are responsive to public needs. By contrast, private sector executives can and do ignore most constituents' demands for direct input to the policy design and operations (Ring and Perry, 1985). Political constraints result in frequent changes in policy, the imposition of short time-horizons and risk aversion on public managers (Bozeman & Kingsley, 1987). Public agencies typically have few rivals for the provision of their services. Even when competition is present, public managers frequently enjoy a dominant position in the market, for example in education and health (Stewart and Ranson, 1988). also argue that 'public sector organizations often are expected to collaborate with other organizations offering similar services and not compete for customers Nutt and Backoff (1993).

Modelling Public Economics after Physics has yielded spectacular advances including Game theory, General equilibrium theory, Economics of uncertainty, long-term economic growth, portfolio theory, rational expectations and option-pricing theory, to name a few. The same does not hold for Macroeconomics as revealed by the recent financial crisis which was essentially a macroeconomic and policy related issue. In the field of Industrial Organisation, empirical research provides little guidance to the regulators in respect of mergers. In most of management research, operationally meaningful equations are rare to find. Conservation laws, symmetry, and the isotropic nature of space are some of the most influential ideas in Physics that simply do not have exact counterparts in other disciplines and management literature abounds with false generalisations. Elegance of solutions should not take priority over importance and usefulness of the questions that need to be asked.

Recently, natural experiments have yielded valuable insights in the fileld of public health (e.g., Albers et al., 2023). Because of the vulnerabilities revealed by the 2008 financial crisis, mathematisation of public economics could become more practical though less elegant. Demand

for quantitative literacy in management education will continue to increase. Much of mathematisation occurred when tools were developed to address the issue of paucity of data. Now there is abundance of data in the public domain and researchers are focussing on choosing the right tools and how best to employ them for analysis. Theory will clarify rather than complicate understanding and beyond identifying the causal effect there is likely to be more emphasis on understanding the mechanism at work. There is cause for optimism on both theoretical and empirical fronts. While physicists are inspired by mathematical elegance and driven by pure logic, forthcoming research in management of public enterprises is likely to take into account the harsh empirical realities.

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