NCRM Collaborative fund project: Adapting econometric causal effect estimators to the public health arena
Final report

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Day One

We organised a one day seminar entitled "Mixing econometrics and epidemiology", this was free to attend but required registration. The seminar day was well attended with over 20 registrants. The schedule of talks was as follows:

1. 11:00 - 11:15 Welcome Coffee
2. 11:15-11:30 Sara Geneletti (Imperial College) **Introduction to the meeting**
3. 11:30-12:30 Lorraine Dearden (Institute of Education) **Evaluation methods in Economics and their possible application to Epidemiology**
4. 12:30-13:30 **lunch break**
5. 13:30-14:05 Philip Dawid (Cambridge) **Beware of the DAG!**
6. 14:05-14:40 Gianluca Baio (University College London/University of Milano Bicocca) **Mixing Econometrics and Epidemiology: the perfect job for Health Economics?**
7. 14:40-15:15 Frank Windmeijer (University of Bristol) **SMM estimation with binary outcomes**
8. 15:15-15:30 **coffee break**
9. 15:30-16:05 Nuala Sheehan (University of Leicester) **Mendelian randomisation and causal inference in epidemiology**
10. 16:05-16:35 **general discussion**

Day two

On the second day, speakers from the seminar day were invited to participate in a brainstorming session. The aim of this session was to consider situations where econometric estimators discussed during the seminar day could be applied to the Public Health arena. We briefly considered two types of estimators, regression discontinuity designs and instrumental variables before going on to discuss how we would tackle an example public health problem.

Regression discontinuity designs

RDDs take advantage of "sharp" threshold and compare individuals who are on either side of this threshold. An example of such a threshold are primary school admissions in the UK which depend on the date of birth of a child rather than the child's age. This can tell us about the effect of age on scholastic achievement as it allows us to compare children who effectively have the same age, but some of whom are born just before the threshold and therefore start school a year before those who are born just after. Lorraine Dearden from Admin has worked extensively on this issue. A similar discontinuity can be seen in many Public Health contexts. A simple example are the thresholds used by GPs and clinicians to determine whether to prescribe drugs to their patients. For example, an individual will be prescribed ACE inhibitors if their Systolic and Diastolic blood pressures are above 140 and 90 respectively, if they fall below these thresholds they will not. To understand whether the ACE inhibitors are effective and also whether the threshold should change it is useful to compare blood pressure changes in individuals who have blood pressures just below the thresholds and who therefore do not receive medication to those who have blood pressures just above the thresholds and therefore receive medication. The idea is that these two groups are not likely to be that different before they receive medication and the sharp thresholds allow us to compare the effect of medication almost as in a randomised trial – limited to those who have blood pressures around the thresholds. RDDs have not yet been absorbed into the Public Health and Epidemiologic literature and there is scope for collaborations and further research in this area. BIAS II are collaborating with their visiting fellows from ISER who are using RDDs to investigate fertility outcomes.

Instrumental Variables and Mendelian Randomization

This is the focus of work by Nuala Sheehan and Frank Windmeijer and we discussed the pros and cons of applying instrumental variable methods from

econometrics to epidemiology using Mendelian randomization. The advantage of using a genetic instrument is that it is believable without too much further justification – this is not always the case in econometrics where it is usually much harder to justify the validity and "randomness" of an instrument. One of the major problems with the approach is that contrary to the general econometric context, the genetic instrument is generally binary. This means that most econometric techniques which are developed for the continuous case and linear models cease to work in this case. Another problem is that the genetic instruments tend to be weak. We discussed whether perhaps more than one gene could be used and a stronger instrument would then be a set of genes. Finally, the gene could be affecting the outcome indirectly (see DAG in Figure 1). Although there has been research showing that most of the genetic instruments that have been used are not pairwise associated with outcomes of interest, there is no guarantee that jointly genes might not affect outcomes. One potential new avenue of research that emerged from this critique was to attempt simulation studies to understand how some genes could be marginally independent of the outcomes of interest but jointly dependent. We also discussed some more fundamental problems with applying econometric estimators which take into account human behaviour such as compliance to the context of genetic instruments as the concept of compliance is difficult to interpret when individuals are complying not to certain behaviours (e.g. participating or not in an adult education programme) but to certain epidemiologic exposures such as BMI.

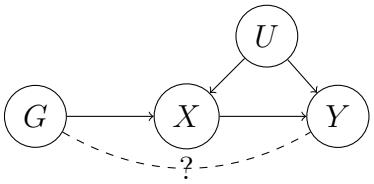

Figure 1: DAG representing the use of the genetic instrument. The dashed line violates one of the IV assumptions

Final comments

Both days were successful and resulted in some in a number of possible avenues of future research and potential collaborations. In particular, RDD appear to offer an exciting and as yet relatively unexplored avenue of research in Epidemiology and Public Health. Our discussion on the use of IV estimators with a genetic instrument revealed that whilst IV estimators

are undoubtedly useful, they might not be as effective as they have been in econometrics.