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Modern research method: Opportunity knock

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ABSTRACT

As economists are working in an increasing complex environment, it is natural that they take advantage of a wider and more advanced set of tools and skills to deliver meaningful solutions. The financial crisis and the advent of big data have been two key drivers in this direction. Through examination of case studies from the UK, research methods are found to be of key importance in addressing the complexity of today's pressing economic questions. Considerable opportunities present themselves to higher education and national institutions that are able to master the application of up-to-date research methods.

1. Introduction

As economists are working in an increasing complex environment, it is natural that they take advantage of a wider and more advanced set of tools and skills to deliver meaningful solutions. The financial crisis demonstrated the complex and intricate nature of the global financial sector. We explore how this negative shock has led economists to re-evaluate and improve their toolkit of research methods. The exploration of big data brings with it many opportunities to benefit from novel and detailed data sets. Big data, however, is not easy to tame. Again economists are relying on a wider and deeper skill-set to harness the value that comes with this change of environment.

I use case studies from the United Kingdom to explore the response being put forward by economists to this changing environment. We find that the need for a more comprehensive toolkit has led to research methods taking a position of rising importance. Questions related to the field of economics are increasingly being approached through research methods developed and used in other academic disciplines. Funding and institutional development is encouraging this inter-disciplinary approach. We find curricula development is also being shaped by the need for emerging scholars highly skilled in up-to-date research methods. We give a taste of some of these developments here. Limited time and space does not allow for a fuller discussion, but it is hoped that these examples will help higher educational institutions see the potential rewards of developing research methods expertise.

1.1 Financial crisis - Is there a silver lining?

The financial crisis of 2008 has led certain leading economists to question the efficacy of our approach to macroeconomics and resulting policy advice. Professor Sir Christopher Pissarides, Regius Professor of Economics at the London School of Economics and nobel prize winner, writes[1]:

"*It became obvious soon after the start of the financial crisis that we did not have the tools to understand it, and were consequently less able to recommend policies to combat it. It also became obvious to us that globalisation and financial development had changed the nature of macroeconomic fluctuations, requiring many different skills within macroeconomics."*

There are two important terms used here by Professor Pissarides: tools and skills. The lack of appropriate tools and skills has been identified as the gap that needs to be filled. If a silver lining can be seen in the cloud of the financial crisis, then perhaps the development of modern tools and skills to tackle today's economic problem is that lining. Here we discuss two such developments in research methods.

2. Modelling structural breaks

A key aspect of the financial crisis was the lack of fore-knowledge. The question of '*why didn't we see this coming?'* was on the lips of many commentators and members of the public. Indeed, The Queen also asked the same question:

"Madam, When Your Majesty visited the London School of Economics last November, you quite rightly asked: why had nobody noticed that the credit crunch was on its way?[2]*"*

In defence of economists, unanticipated shocks to the global economy which occur irregularly and are the product of a number of interlinked factors make the forecasting of structural breaks no easy task. However, a pertinent question being worked on is how we can overcome the problem of being systematically wrong for prolonged periods.

With respect to what the data was showing during the financial crisis, David Viniar, Goldman Sachs's chief financial officer states: [3]

"We were seeing things that were 25-standard deviation moves, several days in a row."

With such changes, it would have been reasonable to ask if current models of the economy were still applicable. Professor Sir David Hendry, Department of Economics, University of Oxford has been focusing his research efforts on analyses of forecasting in the face of structural breaks. Hendry and Clements[4] present a clear and concise picture of the task at hand. The theory of economic forecasting has relied on two key assumptions:

(1) the model is a good representation of the economy; and

(2) the structure of the economy will remain relatively unchanged.

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[1] New Centre for Macroeconomics launched at LSE, London School of Economics Economics Review, 2012/2013, http://www.lse.ac.uk/economics/newsEventsSeminars/files/EconomicsReview20122013.pdf

[2] Letter of the British Academy to Her Majesty The Queen, 22 July 2009. http://www.britac.ac.uk/templates/assetrelay.cfm?frmAssetFileID=8285

[3] Goldman pays the price of being big, Peter Thal Larsen, Financial Times, AUGUST 13, 2007

[4] Working Paper No. 82 Economic Forecasting: Some Lessons From Recent Research, David F. Hendry And Michael P. Clements, October 2001

Structural breaks – defined as sudden large changes, invariably unanticipated – move us into a world where these assumptions are shown to be empirically weak. Professor Hendry has shown that when the processes being modelled are not time invariant, many of the famous theorems of both macroeconomic analysis and forecasting no longer hold.[5]

Novel tools are helping Professor Hendry move forward in his research endeavour and we consider two of these here.

2.1 Nowcasting

Official data has a reputation for being released with delay and then revision. Analysts relying on data that is already three months old is not an uncommon situation. Nowcasting, as the name suggests, uses data on variables released more frequently. By finding statistical relationships between these variables and key macroeconomic indicators, such as GDP and inflation, economists hope to better predict the future state of the economy. New data sources, such as Google Trends, provide disaggregated high-frequency information on a vast scale. This data source facilitates the prediction of breaks in two ways. Firstly, nowcasts provide flash estimates of key macroeconomic indicators. Secondly, agents' reactions to the unfolding of events gives useful information for improving predictions.

Choi and Varian[6] have shown that Google queries do have significant short-term predictive power for a wide set of economic indicators. Examples include automobile sales, unemployment claims, travel destination planning and consumer confidence. While the discussion here is on forecasting, the research methods associated with nowcasting do not limit themselves to this area. The opportunity for academics is to consider how nowcasting could benefit their research trajectories.

2.2 Autometrics

Autometrics has its roots in the general to specific approach (Gets).[7] That is, using empirical evidence to form the model, rather than finding the parameters of a theorised model. Model building under the Gets paradigm can be overwhelming for economists given the plethora of possible variables, outliers and multiple breaks. To investigate a wide range of possible models is a huge task for a single researcher, or even a team of researchers. By drawing on recent advances in computation and search algorithms this problem is eased. Automatic modelling methods, like Autometrics, can create and empirically investigate a considerably larger set of models than any individual.

Such automatic modelling methods are able to distinguish between competing models and do so in a non-static manner. That is, as new data is made available, Autometrics is able to adjust to take into account relevant information. This is essentially done through a range of specification and misspecification tests.

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[5] See, for example, All Change! The Implications of Non-stationarity for Empirical Modelling, Forecasting and Policy, David F. Hendry and Felix Pretis, Oxford Martin Policy Paper, http://www.oxfordmartin.ox.ac.uk/downloads/briefings/All_Change.pdf

[6] Choi, H. And Varian, H. (2012), Predicting the Present with Google Trends. *Economic Record*, 88: 2–9.

[7] For a fuller discussion see: The Methodology and Practice of Econometrics, Edited by Jennifer Castle and Neil Shephard, Oxford University Press, April 2009.

3. Agent-based models

The complexity of financial markets was emphasised by the crisis of 2008. Economists are keen to draw on tools and skills that will allow them to form effective policy in light of this complexity. Increasingly, economists are borrowing from other sciences to fill this gap. Agent-based models (ABM), a research method within complexity social science, is one such example of this. The Institute for New Economic Thinking (INET) at the London School of Economics has a particular emphasis on complexity social science - a viewpoint that suggests that social systems such as economies, markets, and political institutions are networks of dynamically interacting, reflexive agents (e.g. consumers, companies, banks, regulators).[8] Complexity theory has already proven useful in the study of a number of varied areas including managing epidemics, understanding weather patterns and the Internet.

Agent-based modelling is a computational method that enables a researcher to create, analyze, and experiment with models composed of agents that interact within an environment.[9] ABM is well suited to handle complexity, for example, heterogeneous people, households and firms interacting dynamically. Unlike traditional methods, ABM does not require people or firms to optimise, or economic systems to reach equilibrium. For example, a consumer's decision-making process can reflect the want to *suffice*, rather than *maximise*, as many of us do in the real world. This is a significant change from the classical approach to economic modelling, where for example, a rational consumer is assumed to maximise.

ABM is bringing new insight to economic policy-making. Professor J. Doyne Farmer, Professor in the Mathematical Institute at the University of Oxford, is working with the Bank of England to develop an ABM of house prices. The fact that a Professor of Mathematics is working on house prices is interesting in and of itself. It emphasises the need for interdisciplinary teams that can come together with the complementary skill sets needed to solve today's problems. The model includes 5 to 10 thousand heterogeneous households, differing with respect to age, decision-making processes and responses to market conditions.[10] This level of complexity is possible due to advances in computational power. There are some 20 million households in the UK, and as computational power increases, it is expected that the number of agents that can be modelled will increase along with the level of heterogeneity in the model.

The model developed by Professor Farmer *et al* was effective in investigating the impact of the size of the rental and different types of buy-to-let investors on housing booms and busts. A significant topic of interest for policy makers in the UK. The impact of possible interventions to attenuate the house price cycle were also explored. The flexibility inherent in ABM makes it suitable for modelling a number of economic scenarios through a bottom-up approach. Decision rules assigned to thousands of heterogeneous agents combined with growing computational power, allows economists to dig deeper into complex questions such as youth labour choice or the causes of varying economic growth by geographic location. Again, an opportunity which is predicated on knowledge of the research method.

4. Big data

While the financial crisis brings with it a negative tone, big data speaks of considerable opportunity. Yet, both are connected by the need for economists to be equipped with adequate research tools and skills to ask and answer pertinent questions of policy.

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[8] http://www.lse.ac.uk/website-archive/newsAndMedia/news/archives/2011/01/INET.aspx

[9] Agent-Based Models: Quantitative Applications in the Social Sciences, Nigel Gilber, Sage Publications, 2007

[10] Bank of England Staff Working Paper No. 619, *Macroprudential policy in an agent-based model of the UK housing market*, Rafa Baptista, J Doyne Farmer, Marc Hinterschweiger, Katie Low, Daniel Tang and Arzu Uluc, October 2016

Big data usually includes data sets with sizes beyond the ability of commonly used software tools to capture, curate, manage, and process data within a tolerable elapsed time.[11] To gain a sense of the growth of data production, Google has seen 30 trillion URLs, crawls over 20 billion of those a day, and answers 100 billion search queries a month.[12] Moreover, this number is growing.

Opportunities that are coming with big data sets include novel variables, such as data on social connections, through which researchers can gain insights. Other data sets are available in real time or at high frequency. However, these big data sets often come with less structure and higher dimensionality. For example, a consumer's entire shopping and browsing history. This raises many questions for data arrangement and analysis due to data sets moving away from the typical rectangular form; with *N* observations and *K* variables, and with *K* typically a lot smaller than *N*. Economists have been helped in drawing insights from big data through advances made by computer scientists. Here we highlight two particular areas: machine learning and text-based analysis.

5. Machine learning

Much of applied econometrics is concerned with detecting and summarizing relationships in the data. To summarize relationships in the data (linear) regression analysis is a key part of an economists toolkit. However, big data can often be better summarised through relationships that are not simple linear models. In an attempt to assess these alternative models, economists are starting to take from tools traditionally developed under the field of machine learning. Examples of such tools include decision trees, support vector machines, neural nets and deep learning.

Professor Hal Varian, emeritus professor in the Department of Economics at the University of California at Berkeley, writes[13]:

"My standard advice to graduate students these days is go to the computer science department and take a class in machine learning."

Again, this speaks of the need for economists to have access to an up-to-date toolkit so that full advantage can be taken of the available data. It also emphasises the need for inter-departmental working to facilitate high quality research. As way of example of the sort of complex problems that are being studied, Professor Paul Longley is leading University College London's contribution to two multimillion pound grants that will fund a Consumer Data Research Centre (CDRC).[14]

Consumer-related data are data generated by retailers and other service organisations as part of their business process. They can be used to monitor the needs, preferences and behaviours of customers. One of the key research trajectories will be to use the big data collected to understand how economic growth is driven. This will help to improve the evidence base to inform policy development, implementation and evaluation, without compromising the privacy of individuals.

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[11] Snijders, C.; Matzat, U.; Reips, U.-D. (2012). "'Big Data': Big gaps of knowledge in the field of Internet". *International Journal of Internet Science*. **7**: 1–5.

[12] Google: 100 billion searches per month, search to integrate gmail. Danny Sullivan, Search Engine Land, 2012. http://searchengineland.com/google-search-press-129925.

[13] Big Data: New Tricks for Econometrics, Hal R. Varian, June 2013, Revised: April 14, 2014, http://people.ischool.berkeley.edu/~hal/Papers/2013/ml.pdf

[14] For further details on CDRC, see https://www.cdrc.ac.uk/

6. Text-based analysis

Often, when we talk of data, it is numerical data that comes to mind. However, every day we express ourselves in 500 million tweets, 64 billion WhatsApp messages and 864 million people log in to Facebook to communicate.[15] This data set is growing day by day and showing more promise for impactful studies as research methods advance to allow us to make sense of it.

Text brings with it issues of syntax, emotion and tone. If we are able to meaningfully translate this data into information in a cost-effective manner, a myriad of research trajectories would open up. Advances in research methods are gradually making this possible. Brendan O'Connor et al argue that automated content analysis of text, which draws on techniques developed in natural language processing, information retrieval, text mining, and machine learning, should be properly understood as a class of quantitative social science methodologies.[16] The authors provide a summary of interesting works in the field of economics. Examples include: How does sentiment in the media affect the stock market?[17] What determines a customer's trust in an online merchant?[18] How can we measure macroeconomic variables with search queries and social media text?[19]

The common thread in all these studies is the use of text-based data to generate new insights. By using new methods, previous studies can also be revisited. For example, academics have previously sought to establish which themes, such as microeconomics or labour economics, have been the focus of recent economic research. To do this, previous studies would focus on the content of published articles in top journals as a proxy for research output. This is a costly process, with researchers having to read each article one by one, perhaps looking for key words in the title or abstract, and then entering this information manually into a database to be analysed. Given the workload associated with such a task, their data set was small - typically one year's worth of journals.

By using computer-aided text analysis, the same question can now be asked in a richer manner. A more recent study[20] analysed journal articles over a 50 years period, analysing not just abstracts, but the full article. By doing so, trends over a longer period could be established, as well as considering trends within sub-samples of the population which were not previously large enough to warrant analysis.

The above examples provide a window into the promise of text-based analysis. Given the large and growing production of text-based data, there is a clear opportunity for those who can master the relevant tools associated with text-based analysis. It is worth noting here that the focus on application, rather than theoretical development, offers low-hanging fruit for researchers. That is, the tools do not need to be developed by all. Specialists have been, and continue to, refine and improve the tools needed to analyse text. Academics need only learn how to apply these tools and interpret the results in their own specialist area in order to put forward impactful research.

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[15] Why words are the new numbers, Magazine article: Capital Ideas, The University Of Chicago Booth School Of Business, Amy Merrick, March 02 2015, http://www.chicagobooth.edu/capideas/magazine/spring-2015/why-words-are-the-new-numbers

[16] Computational Text Analysis for Social Science: Model Assumptions and Complexity, Brendan O'Connor, David Bamman, Noah A. Smith, *Proceedings of the NIPS Workshop on Computational Social Science and the Wisdom of Crowds*, 2011.

[17] Paul C. Tetlock. Giving content to investor sentiment: The role of media in the stock market. *The Journal of Finance*, 62(3), 2007.

[18] Nikolay Archak, Anindya Ghose, and Panagiotis Ipeirotis. Deriving the pricing power of product features by mining consumer reviews. Management Science, 2011.

[19] Nikolaos Askitas and Klaus F. Zimmermann. Google econometrics and unemployment forecasting. *Applied Economics Quarterly*, 55(2):107–120, April 2009

[20] Lea-Rachel Kosnik (2015). What Have Economists Been Doing for the Last 50 Years? A Text Analysis of Published Academic Research from 1960–2010.*Economics: The Open-Access, Open-Assessment E-Journal*, 9 (2015-13): 1—38. http://dx.doi.org/10.5018/economics-ejournal.ja.2015-13

7. Institutional change

In a review of publications in top economics journals, Hamermesh identified a clear shift from theoretical papers accounting for the majority of journal articles until the mid-1980s, to empirical papers which by 2011 accounted for more than 70% of published articles.[21] This shift towards empirical analysis brings with it an increased focus on research methods. This has been recognised by national institutions in the UK. In particular, inter-disciplinary institutions that seek to take the best from all relevant fields are being formed to help address the complex global questions of today.

One example of this is the Institute for New Economic Thinking at the Oxford Martin School (INET Oxford). Established in May 2012, INET Oxford is a multidisciplinary research institute dedicated to applying leading-edge thinking from the social and physical sciences to global economic challenges.[22] It draws expertise from 60 academics in 15 different disciplines. Their Economic Modelling Programme aims to develop new methods of economic analysis and forecasting that are robust after crises.

The Alan Turning Institute is another interesting development. Its focus is on data science - drawing insight from the billions of gigabytes of data generated globally every day, and their powerful impact on our society, economy and way of life.[23] The importance of such institutions can be seen by the partners coming together to form it. In the case of the Alan Turning Institute, partners include five leading universities, firms from the technology and banking sectors and government departments.

The Centre For Macroeconomics is a research centre that brings together a group of world-class experts to carry out pioneering research on the global economic crisis and help design policies to alleviate it.[24] It is a response to the growing call for new techniques to help answer today's problems. Indeed, the CFM has as one of its key research trajectories the development of new methodologies. The contribution of such institutions is readily recognised by leading funding bodies, with the Economic and Social Research Council (ESRC), the UK's largest funder of research on economic and social issues, providing funding for the Centre.

At a university level, research methods have always played a core role in teaching. What we see now, however, is the rise of inter-disciplinary centres with research methodology as the focus, rather than the focus being on the field of application such as economics or criminology. This development is reflective of a growing recognition of two factors:

- a research methodology developed in one faculty (e.g. statistics) could also benefit another faculty (e.g. psychology); and
- there are economies of scale in pooling resources. Example of centres that have been set up to cascade the expertise held in one department of the university to other departments include:
- University of Cambridge, Social Sciences Research Methods Centre.[25] The centre offers over thirty courses on research methodologies relevant to students from a variety of faculties (e.g. economics, law, sociology and international relations).
- University of Oxford, Social Sciences Division. A full catalogue of training opportunities, from short courses through to two week intensive options, are available through the year.[26] These courses are aimed at post-graduate and early career researchers within the University.

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[21] D. S. Hamermesh, Six decades of top economics publishing: Who and how? *Journal of Economic Literature*, 51, 162–172 (2013).
[22] For further details see http://www.inet.ox.ac.uk.
[23] For further details see https://www.turing.ac.uk/about-us.
[24] http://www.centreformacroeconomics.ac.uk/About/About-CFM.aspx
[25] For further details see: http://www.ssrmc.group.cam.ac.uk.
[26] For examples see: http://researchtraining.socsci.ox.ac.uk/course-directory?course_type=1.

- University of Essex, Social Science Data Analysis Summer School.[27] Approximately 30 courses at foundational, intermediate and advanced levels are offered over a two-week period. These courses are open to students nationally who wish to benefit from an introduction to a topic or move all the way through to an advanced level.

In recognition of the growing importance of up-to-date research methods, we find a change in the types of degree programmes being offered. Whereas research methodologies used to be subsumed within the study of a subject (such as economics or statistics), the growing importance of the toolkit through which we can reach insights, has now switched this ordering. That is research methodology is starting to be seen as the major and the subject specialisation as the minor.

Leading this approach is the Department of Methodology, part of the London School of Economics. The Department has two key functions: to provide short-course training for students and staff, and to host degree programmes in Social Research Methods.[28] The emphasis, particularly for the MSc in Social Research Methods, is to give researchers the key skills that future employers are looking for. Hence it is focused on teaching a wide range of research methods - the major part of the programme. Students are then able to choose a specialist option in a particular field of study, for example, sociology or development studies.

8. Final thoughts

The rising importance of research methods brings opportunities and challenges for aspiring higher educational institutions. The challenge is to critically evaluate the current development and delivery of curricula - are graduates being given those skills and tools needed to answer the pressing economic questions of today? At a national level a similar question can be asked - do policy makers have access to analysts and academics with the skill-set to model, experiment and draw insights that are reflective of the complex world we operate in?

There is significant opportunity for institutions that can overcome the inertia inherent in change. While the development of new research methods is often a highly specialised and difficult task, the application of these methods to find solutions is not so. Hence, a focus on application of research methods provides quick returns for those wanting to move in this direction. The importance of inter-disciplinary research should not be ignored. If economists are to equip themselves with the tools and skills that are needed for today's problems, an excellent starting-point is to benefit from the tools and skills developed and improved by academics in neighbouring faculties. One faculty that is showing itself as particularly important is that of computer science. How the skill set from this faculty can be effectively leveraged to benefit research in other faculties is a pertinent question for higher education leaders.

For universities, the centralised teaching of research methods provides a cost-effective way to deliver training to all faculty areas. The aim is to leverage advancements in research methods to support current faculty members and researchers as well as future students. A by-product of centralised training is the encouragement of inter-disciplinary research - as students and academics from differing faculties and with different research areas find a common link through research methods. Positive developments along these lines are already taking place, and it is hoped such developments will continue.

[27] See: http://essexsummerschool.com
[28] See: http://www.lse.ac.uk/methodology/Home.aspx