Institution: University of St Andrews

Unit of Assessment: 18 – Economics and Econometrics

Title of case study: Influence on Macroeconomic Policy

1. Summary of the impact (indicative maximum 100 words)

Economic models with adaptive learning developed in Mitra's research are increasingly being adopted by policy authorities and in the training of graduate students. The usual paradigm in economics, rational expectations (RE), unrealistically assumes complete knowledge on the part of policymakers and households. Mitra's work has emphasised informational limitations faced by policymakers and provides guidance for policies in these situations. Monetary policy is an area where different types of models are heavily used and their results are one input to the policy decisions. The impact of this case study should be seen by virtue of pioneering an approach that has come to be accepted by the economics profession as the realistic one to analyse macroeconomic policy changes under bounded rationality; this approach has led to a large outgrowth of applied models used in policy making in recent times. These policy oriented works have provided support for the aggressive monetary and fiscal stimulus packages that have been adopted in the wake of the financial crisis in 2007. They have been disseminated widely through presentations at numerous conferences sponsored by central banks in the presence of senior policymakers. The research has also influenced the teaching of macro and monetary economics; it is part of reading lists of leading MPhil/PhD programmes and has in part contributed to PhD students specialising in this broad area of research.

2. Underpinning research (indicative maximum 500 words)

The main paradigm in macroeconomics is RE. Agents need to have an unrealistically complete level of knowledge about the economy in order to be able to form RE. An alternative approach assumes that agents (households, firms and policy makers) have incomplete understanding and improve their knowledge by using simple methods. In this "adaptive learning" approach, households/central banks have vague ideas of how the economy functions and gradually improve their understanding based on observed data (inflation, GDP). Policymakers find this type of analysis attractive since it is closer to their own way of thinking about the real economy. The Chairman of the Federal Reserve said in a speech in 2007 that "many of the most interesting issues in contemporary monetary theory require an analytical framework that involves learning by private agents and possibly the central bank as well." While President of the ECB said in a speech in 2010, when discussing the limitations of existing economic and financial models that "we may need to consider a richer characterisation of expectation formation. Rational expectations theory has brought macroeconomic analysis a long way over the past four decades. But there is a clear need to re-examine this assumption. Very encouraging work is under way on new concepts, such as learning and rational inattention." This case study is built around Impact stemming from adaptive learning models developed by Mitra.

The focus of the early literature on adaptive learning was on whether agents can behave as if they had RE in the long run, usually in *ad hoc* models. Bullard and Mitra analysed monetary policy design in situations with incomplete knowledge in the now standard micro-founded New Keynesian (NK) model. Stability under adaptive learning (*learnability*) was accepted as an additional criterion for good macroeconomic policies; certain policy choices can lead to bad outcomes (in terms of high inflation or output volatility) while others lead to good outcomes. The approach used (the Euler Equation (EE) approach) assumed that agents' decision horizon was short; this assumption limited their usefulness even though important policy insights were obtained. An alternative approach that emphasised agents have a long (even infinite) decision horizon was developed in the middle of the past decade. This is the infinite horizon (IH) approach relevant here.

When Mitra arrived at St Andrews in 2006, he began a new research programme to evaluate the IH and EE approaches. With Dr Honkapohja (Bank of Finland) and Prof. Evans (Professor of Economics at the University of Oregon and part-time Professor at the University of St Andrews since 2007), he clarified the subtle connections between the approaches, showing both to be valid ways of analysing monetary policy in HME (2013) [1]. In a major study, Evans, Honkapohja and Mitra [2] developed techniques and first results on how to model bounded rationality when

policymakers make announced policy changes. These techniques emphasized that the IH approach is the natural way to analyse macroeconomic policy *changes*. Fiscal/tax changes involve long delays in their implementation (often exceeding two years), and in these situations the IH approach is the sensible one; it allows households/firms to react to policy announcements in advance of the policy change. In contrast, under EE learning, agents do not react to announcements until the policy change takes place which makes it implausible in these situations. It was recognised that the IH approach, being forward looking, has merits in analysing future policy changes. This is the theme of Mitra's work since 2006 supported by an ESRC grant [6] where he is the sole investigator. This research has produced additional papers [3, 4, 5 and EM2013] expounding the benefits of the IH approach in analysing policy changes; e.g. [3] has been cited in an important survey published by a leading international monetary economist in the Annual Review of Economics. The work of Mitra and co-authors [4, 5] are seminal papers that introduce adaptive learning to examine the effects of (surprise and anticipated) fiscal policies in a neoclassical model. They show that the assumption of RE gives a misleading picture about the effects of fiscal policy measures. When adaptive learning is realistically incorporated, fiscal stimulus packages have a much bigger potential in increasing GDP. This approach has also inspired work (discussed below) in addressing other major policy concerns.

3. References to the research (indicative maximum of six references)

1. Honkapohja, S., K. Mitra and George Evans (2013), "Notes on Agents' Behavioral Rules Under Adaptive Learning and Studies of Monetary Policy", Ch. 4 in *Macroeconomics at the Service of Public Policy* (edited by Thomas J. Sargent and Jouko Vilmunen), Oxford University Press. DOI: 10.1093/acprof:oso/9780199666126.003.0005.

The book has been edited by the 2011 Nobel Laureate in Economics (Thomas Sargent) and has been published by a world-leading academic publishing establishment.

2. Evans, G., S. Honkapohja and Kaushik Mitra (2009), "Anticipated Fiscal Policy and Adaptive Learning", *Journal of Monetary Economics, 56, 930-953.* DOI: 10.1016/j.jmoneco.2009.09.007

This is a top peer reviewed international journal in macroeconomics ranked 4 star by ABS.

3. Evans, G., S. Honkapohja and Kaushik Mitra (2012) "Does Ricardian Equivalence Hold When Expectations Are Not Rational?", *Journal of Money, Credit, and Banking, 44, 1259-1283, lead article*. DOI: 10.1111/j.1538-4616.2012.00531.x

This is a highly regarded peer-reviewed international journal in macroeconomics.

4. Mitra, K., G. Evans and S. Honkapohja (2013) "Policy Change and learning in the RBC Model", *Journal of Economic Dynamics and Control*, 37, p.1947-1971*, lead article*. http://www.sciencedirect.com/science/article/pii/S0165188913001176

This is a highly regarded peer reviewed international journal in economics ranked 3 star by ABS.

5. Kaushik Mitra, Evans, G. and Seppo Honkapohja (2013) "Fiscal Policy and Learning". This has previously appeared as Centre for Economic Policy Research (CEPR) Discussion Paper No. 8891, March 2012. http://ideas.repec.org/p/san/cdmawp/1202.html

This is a highly prestigious and one of the most widely circulated working paper series in economics focusing on relevant policy issues.

6. Economic and Social Research Council (ESRC) Grant Reference: *RES-062-23-2617* "Macroeconomic Policy Changes and Adaptive Learning" from October 2010- September 2013. Award Value: £259,000 at Full Economic Cost with Mitra as the Sole Principal Investigator.

4. Details of the impact (indicative maximum 750 words)

As mentioned before, monetary policy is an area where different types of models are heavily used with the results being one input to the policy decisions. [S1] Hence, it was only natural that research on monetary policy and learning got attention in policy circles as evidenced in the speeches by the Chairman of the Federal Reserve and the President of the ECB. [S2]. An indicator is the number of conferences devoted to this topic, at least 14 of which have been sponsored by central banks including those by the Federal Reserve St Louis 2006-08 and 2012, European Central Bank (ECB) 2006, the Central Bank of Chile 2007 and the Bank of Spain 2013. [S3, S4, S5] It must be recognised that the impact of the underpinning research is largely indirect. As discussed in Section 2, the underpinning research in EHM (2009) [2] and HME (2013) [1] pioneered a methodological approach that is now increasingly adopted by the economics

profession in addressing a series of issues that are of major concern to policy makers; these include issues in both monetary and fiscal policy. In particular, the underpinning research has contributed to an outgrowth of research papers that have influenced discussion among policymakers about the need for aggressive monetary and fiscal policy in the wake of the recent Great Recession. The work has also influenced the worldwide teaching of macro and monetary economics; it is part of the subject matter taught in leading MPhil/PhD programmes and has created a flow of PhD students specialising in this broad research area internationally. [S1, S6]

Macroeconomic Policy

As background, there has been considerable interest in the adaptive learning approach as a way of analysing monetary policy in central banks, e.g. see ECB working paper1316. Since central banks are very secretive about the way they arrive at policy decisions, the evidence of impact from the research on learning to policy making is necessarily indirect. One way to gauge the impact of this literature is to note that key people involved in this particular research participate in monetary policy making decisions in central banks. This is true for the Presidents and CEOs of the FRBs of St Louis and San Francisco who participate in discussions of policy options available to the Federal Open Market Committee (FOMC), the key monetary policy making committee in the US. The San Francisco FED President continues to do research on this topic, presenting related work in the 2012 Learning Workshop in the FRB of St Louis and hosting a conference on the same topic in 2013 in the San Francisco FED. The St. Louis FED President was a keynote speaker at the CDMA conference "Expectations in Dynamic Macroeconomic Models" in September 2011 at the University of St Andrews [S3], which initiated the conferences of the same name at the FRBs in 2012 and 2013. In addition, Prof. Mitra's long-term co-author Dr Honkapohja is a Member of the Policy Board of the Bank of Finland, which participates in ECB policy.

The underpinning research in Section 2 has broadly convinced the profession that the plausible way to analyse policy changes under bounded rationality is by using the IH approach. The methodology has inspired a range of work in macroeconomic policy issues that in turn have been very influential in affecting public discourse. A selection of these issues is outlined below.

One piece of work has been the effects of fiscal policy on output in economic models. Mitra, Evans and Honkapohja (2013) [4, 5], henceforth MEH, show that increases in output can be significantly higher under adaptive learning and fall within ranges reported in the empirical literature. This work provides support to the fiscal stimulus packages that have been adopted in various countries in the aftermath of the recent Great Recession; a striking example is the American Recovery and Reinvestment Act (ARRA) implemented in the US in February 2009. In contrast under the (unrealistic) assumption of RE, the impacts of fiscal stimulus on output are very low and well outside the range found in empirical studies; thus under RE, there is little or no support for the recent aggressive policies. Mitra has presented [5] at the First Workshop [S7] of the International Network on Expectational Coordination (INEXC) in Paris, 2012, which is an initiative supported by the Institute for New Economic Thinking. This work was also presented by Mitra's co-author as part of a keynote talk at the July 2012 FRB St Louis Conference on "Expectations in Dynamic Macroeconomic Models as discussed above, in the presence of the Presidents of the Federal Reserve Banks of San Francisco and St Louis (and other members in policy circles) [S3].

In the wake of the economic crisis in 2007, central banks have had to lower their interest rates to almost zero, creating an unprecedented situation with various uncertainties. The methodology explained in Section 2 is a very natural modelling approach to analyse these situations and there are an increasing number of studies using this approach. One example is the analysis of problems, that could arise from the economy being stuck in a deflationary state for a prolonged period of time especially when the interest rate is at very low levels, and the consequent macroeconomic policies that might be needed to pull the economy out of this state. This was clearly a major concern in the US in the early 2000s which in turn was partly influenced by the earlier experience of Japan in the 1990s. "Expectations, deflation traps and macroeconomic policy" by Evans and Honkapohja which uses the approach of EHM (2009), received widespread attention in policy circles including at numerous conferences organised by central banks, e.g. by the Swiss National Bank and Norges Bank in 2009 and by Erasmus University in 2010 [S4, S8]. These conferences were attended by important personalities in central banking circles including Governors of the Central Banks of Cyprus and Norway and the Deputy Governor of the Central Bank of Sweden; see also "Seven Faces of The Peril" by the President of the St Louis FED. Like MEH [5], this work has justified the

type of aggressive monetary and fiscal policies that have been adopted in countries since the onset of the Great Recession. This is further detailed in the separate case study of Evans titled "Policy advocacy for economies in deep recessions".

The IH approach in EHM (2009, 2012) [2, 3] has also inspired a related strand of work on the effects of fiscal stimulus and austerity. Whether governments should undertake fiscal stimulus to reduce unemployment or engage in austerity because of rising concerns about debt is a hotly debated topic since the advent of the Great Recession. Historically, some fiscal consolidations have turned out to be expansionary and MEH [5] show that the empirical effects of these consolidations are well captured by the assumption of adaptive learning under the IH approach; in sharp contrast, the assumption of RE fails to replicate important features present in the data for these episodes. "Liquidity Traps and Expectation Dynamics: Fiscal Stimulus or Fiscal Austerity" by Benhabib, Evans and Honkapohja (2012) further analyses the global dynamics of fiscal policies in the New Keynesian model using the IH approach of EHM when the interest rate is subject to the zero lower bound. This paper has been presented at the FRB St Louis workshop in 2012 attended by the Presidents of the FRBs of San Francisco and St Louis and at the Bank of Spain Workshop in 2013 also attended by central banking personalities including the Deputy Governor of the Bank of Spain [S3, S5]. A Board Member of the Bank of Finland has cited this work in a speech given in Istanbul in June 2012 [S9]. This work has emphasised the importance of taking the (zero) lower bound on interest rates into account when formulating macroeconomic policies.

Graduate Training

Mitra's underpinning research exemplified by the work listed in section 3 has made the learning literature more mainstream in macro and monetary economics and has impacted the way the subject is taught in MPhil/PhD programmes in a range of universities worldwide. Learning topics have been taught in PhD courses in top institutions like Harvard, Princeton, Columbia, Cambridge, Oregon and Washington University, St Louis. Mitra was invited to teach an MPhil course (S210) on "Learning and Macroeconomic Policy" at the University of Cambridge in 2008 [S6]. Evans, Honkapohja and Mitra (2012) [3] has been in the reading list of the second-year PhD course "Imperfect Knowledge and Macroeconomics" at Harvard University and EHM (2009) [2] has appeared in the reading lists of courses taught in institutions like Cambridge, Oregon and University of California Irvine. [S6] Several PhD students specialising in topics using the learning approach in macroeconomic policy have graduated from a range of institutions including the University of Vienna, University of California Irvine, Columbia and Princeton. [S1]

5. Sources to corroborate the impact (indicative maximum of 10 references)

S1. Letter by Member of the Governing Board, Bank of Finland, to corroborate the influence the case study has had on macroeconomic policy and graduate student training outlined in Section 4.

S2. Speech by Chairman of the Federal Reserve, 2007, and by the President of the ECB, 2010. Discussion of research in speeches.

S3. Workshop on Expectations in Dynamic Macroeconomic models in FRB of St Louis, 2012, and at the CDMA, University of St Andrews, 2011. Discussion of research.

S4.Norges Bank Monetary Policy Conference 2009 "Inflation Targeting Twenty Years On" (12 June) and 11th Annual Conference of the Central Bank of Chile, "Monetary Policy Under Uncertainty and Learning". Discussion of research at conferences.

S5. Bank of Spain, April 2013 workshop on Expectations and Macroeconomics. Discussion of research.

S6. Reading lists of MPhil course S210, Cambridge, 2008, "Imperfect knowledge in macroeconomics" Dept of Economics, Harvard, 2011, "Learning and Bounded Rationality", UC Irvine, 2013, and ISCTE-IUL, Lisbon, Portugal, 2013. Research incorporated at HEIs.

S7. First INEXC Conference, Paris, 2012; see also INET. Discussion of research.

S8. Swiss National Bank, 2009 "Financial Markets, Liquidity and Monetary Policy" and "Expectations, Asset Bubbles and Financial Crises", Erasmus University Rotterdam 2010. Discussion of research.

S9. "How did the crisis challenge the Central Banking as we knew it? What should (not) change?" Speech by Board Member, Bank of Finland, in Istanbul, 5 June 2012. Discussion of research in a speech.