

Project no. 296777
NESS – Non-Equilibrium Social Science in ICT and Economics

Programme: FP7-ICT
Instrument: Coordinate and Support Action (CSA)
Start date of project: 2011-11-01
Duration: 48 months

Deliverable D7.1

NESS in real world policy and modelling

Organisation name of lead contractor for this deliverable: University of Fribourg
Submission date: 2012-12-20
Dissemination Level: Public (PU)

Project co-funded by the European Commission within
the Seventh Framework Programme (2007-2013)

Document information

1.1 Author(s)

Author	Organisation	E-mail
Matúš Medo	University of Fribourg	matus.medo@unifr.ch

1.2 Other contributors

Author	Organisation	E-mail
Jorge Louçã	University Institute of Lisbon	jorge.l@iscte.pt
Paul Ormerod	Volterra Partners	pormerod@volterra.co.uk
Bridget Rosewell	Volterra Partners	brosewell@volterra.co.uk

This deliverable further uses material provided by participants of NESS workshops.

1.3 Document history

Version	Date	Change
V1.0	20. 12. 2012	Final version submitted to the EU

1.4 Document data

Keywords: economics, economic policy, social science, networks, non-equilibrium systems, modelling
Editor address data: matus.medo@unifr.ch
Delivery date: 20 December 2012

Executive summary

We review discussions and highlights within the project NESS on policy (in particular economic policy) and modelling of economic systems. It is split in three parts. In the first part, we present a welcome to NESS, a brief view on an example of real world policy based on network effects, and finally a view on recent trends in social computing as seen by NESS partners.

In October 2012, NESS members Bridget Rosewell, the lead speaker, and Paul Ormerod debated macro policy with Nobel prize laureate Paul Krugman and Richard Layard at a meeting organised in the House of Commons, London and chaired by the Economics Editor of the BBC. The two position papers circulated before the discussion are presented in the second part of this deliverable. The NESS members pointed out the work of Reinhardt and Rogoff, the latter a former Chief Economist to the IMF. They surveyed world financial crises over the last 200 years and showed that when the debt to GDP ratio gets to 90 or 100 per cent, the risk of a loss of confidence in the markets rises sharply. In other words, there is a potential tipping point in the response of the economy to increases in public debt. NESS partners argued in the debate that the UK is very close to that point now.

In the third part, we present selected brief statements of participants of the workshop on Grand Challenges in Non-Equilibrium Science which was organised by NESS in Brussels in March 2012. These statements by high-profile speakers are then supplemented with impressions from the workshop by two junior researchers (Bassel Tarbush and Magda Roszczynska-Kurasinska). Since we are in an early stage of NESS when the ideas, goals, and community of NESS are still rapidly developing. With respect to policy-makers, the initial events have led to the following points:

- The paradigm based on agents optimising their behaviour needs to be extended to include copying behavior where a large fraction of agent decisions is based on interactions with other agents and copying locally successful moves. This immediately makes the notion of a representative agent obsolete (such an agent would have no one to copy from) and can be successfully used to describe various situations. More analytical and simulation efforts are needed to pursue this line of thinking further.
- The approach of non-equilibrium social science may raise the fear that the incorporation of complexity into models will make the models too difficult to understand and be of use. Contact with end-users and well defined measures are needed to make highly complex models produce results that can be comprehensible and easily used by policy makers.
- An efficient system has little resilience, and apparently robust systems are often fragile and subject to cascades of failure. This has important design, policy, and social implications which need to be studied in detail.

Introduction

This deliverable reviews discussions and highlights within the project NESS on policy (in particular economic policy) and modelling of economic systems. It is split in three parts. In the first part, we present a welcome to NESS, a brief view on an example of real world policy based on network effects, and finally a view on recent trends in social computing.

In October 2012, NESS members Bridget Rosewell, the lead speaker, and Paul Ormerod debated macro policy with Nobel prize laureate Paul Krugman and Richard Layard at a meeting organised in the House of Commons, London and chaired by the Economics Editor of the BBC. The two position papers circulated before the discussion are presented in the second part of this deliverable.

In the third part, we present selected brief statements of participants of the workshop on Grand Challenges in Non-Equilibrium Science which was organised by NESS in Brussels in March 2012. These statements by high-profile speakers are then supplemented with impressions from the workshop by two junior researchers (Bassel Tarbush and Magda Roszczynska-Kurasinska).

Part 1 – Viewpoints by NESS partners

1.1 Welcome to Non-Equilibrium Social Science (P. Ormerod)

The purpose of NESS (<http://www.nessnet.eu/>) is to try to ensure that the social sciences are put on a proper footing for the 21st century. A key focus of the group is economics, where the equilibrium approach (though dominant) struggles to capture the economic realities we observe in the world today. But we are interested in all the social sciences. NESS is a genuine trans-disciplinary venture.

The main deliverable required of the NESS project is a road map to inform the EU's funding strategy on social science research in Horizon 2020, the successor to the current European funding framework, FP7.

Modern computer techniques have made possible both the integration of larger information sets and the exploration of disequilibrium behaviour. However, we are still in the infancy of making the best use of simulation and multidisciplinary analysis.

NESS aims to establish a network of leading scholars and practitioners from all social science disciplines to apply and focus these advances to make real progress in understanding complex social and economic systems.

NESS is oriented towards more formal modelling approaches in the context of data and observation, but ones in which process and time are of fundamental importance. Most real world social and economic behaviour takes place out of equilibrium.

We will be holding a series of workshops and events over the next three years, and would be delighted to hear from like-minded social scientists from anywhere in the world.

1.2 Social networks can spread the Olympic effect (P. Ormerod)

After a summer of sport, the London Olympics and Paralympics have ended and the city is now returning to normal. For London, normal means roads and public transport that are crammed, especially at peak times. It was all very different during the games, when many of the streets and shops in this dynamic city were eerily deserted. What made behaviours change so dramatically? And what lessons can be learned for behaviour change in other arenas?

Congestion was a potential major headache for the organizers of the Olympics. The conventional way to prompt a change in behaviour such as driving is to use incentives, the price mechanism beloved of economists. There is already a congestion charge for vehicles entering the city centre, so this could have been ramped up. And a special levy could have been introduced for travel on public transport.

But the increases in price would have had to be enormous to deter people, so London relied instead on social-network effects. Before the games, a massive publicity campaign focused on how crowded the centre of the city would be. Bus and train passengers, for example, were bombarded at regular intervals with recorded announcements from mayor Boris Johnson that warned just how busy public transport would be, and urged people to avoid them if they could.

The strategy worked — too well in fact — because of feedback effects. People do not receive such warnings as isolated individuals: they discuss them widely with friends and work colleagues. Employers reinforced the effect by promoting special arrangements for home-working and flexible hours. As a result, commuting cyclists had many roads to themselves and visitor numbers at flagship London venues fell by one-third.

Johnson gave us a glimpse of public policy as it could be applied in the twenty-first century, relying on network effects rather than on incentives. In the twentieth century, both social and economic policy in the West were dominated by the principles of conventional economic theory: individuals with fixed tastes and preferences took decisions in isolation, and reacted to changes in incentives. So to achieve a policy goal, politicians would change tax rates and offer subsidies. This model is not wrong. But it is an incomplete picture of the way in which the world now operates.

Network effects are not new. Throughout history, a crucial feature of human behaviour has been our propensity to copy or imitate the behaviours, choices and opinions of others. We can see it in the fashions in pottery in the Middle Eastern Hittite Empire of three-and-a-half millennia ago. But we are now much more aware of what other people are doing, or plan to do. For the first time in human history, more than half of us live in cities, in close, everyday proximity to large numbers of other people. And the Internet has revolutionized communication.

Network effects are not new. Throughout history, a crucial feature of human behaviour has been our propensity to copy or imitate the behaviours, choices and opinions of others. We can see it in the fashions in pottery in the Middle Eastern Hittite Empire of three-and-a-half millennia ago. But we are now much more aware of what other people are doing, or plan to do. For the first time in human history, more than half of us live in cities, in close, everyday proximity to large numbers of other people. And the Internet has revolutionized communication.

Social networks are often thought of as a web-based phenomenon: Facebook, for example. Such forums can indeed influence behaviour. But real-life social networks — family, friends,

colleagues — are even more important in helping to shape preferences and beliefs.

Social problems such as obesity are driven by network effects. It is not that people decide to copy fat friends and eat huge amounts; here, the network effect is one of peer acceptance. If most of your friends are obese, then it is more acceptable for you to put on weight. The problem of worklessness is also driven by networks. My home town of Rochdale, UK, attracted notoriety a couple of years ago when 84% of working-age adults on one council estate were found to be on benefits. Yet estates with very similar socioeconomic backgrounds had much lower rates, although still high by national standards. The social values of some estates had evolved to make being on benefits the norm.

A great deal of Europe's economic policy can be seen as an attempt by various players to use the social-network effect to get their narrative version of events to 'go viral' and dominate financial markets, almost without regard to objective reality. For example, although the United Kingdom has a higher public-sector debt relative to the size of its economy than, say, Spain, the United Kingdom is perceived as sound and Spain as risky.

Thanks to advances in network theory, we now know much more about how behaviour is spread and contained across networks than we did even ten years ago. Something that is particularly disturbing for policy-makers is the inherent level of uncertainty: some network effects simply fail to spread, and it is impossible to predict accurately how much traction an idea will get, and how any one event will unfold.

Tackling social, economic and global issues, such as climate change, will require real, fundamental changes to behaviour. To make this a reality, policy-makers, in both the public and the corporate sphere, will need to radically change their view of how the world operates. The inherent uncertainties of social networks make policies much harder to implement, so network theory must come up with effective, practical tools that help policy-makers to achieve their goals. For when they work, as we saw in London, social networks are a powerful and useful way to get things done.

1.3 Social computing (Jorge Louçã)

In the short period of a couple of weeks, two European meetings addressed the subject of Social Computing. The first one was the “Scientific Meeting on Social Networks and Social Media”, organized by Yasmin Merali and Pietro Lio in Cambridge, on the 18th and the 19th of January. Talks addressed several aspects concerning Network Theory, Geo-Social Networks, as well as applications to diplomacy, and the concept of The Wisdom of Crowds. The most participated discussions were around the mutual influence between Social Networks and Social Media, namely their influence in the recent Arab Spring events. The other meeting, entitled “On Computing and Social Clouds”, was organized by Kemal Delic at Hewlett-Packard, Grenoble, on the 20th of February.

Complementary to the first one, this meeting addressed how computing clouds can be, in a near future, huge aggregates of computing, communicating and storing facilities available globally and serving hundreds of millions of users. The new technology will improve economies of scale and spawn an entirely new class interaction domains and commercial exchanges.

These two scientific meetings, together with others planned for the next months in Europe and US, showed how emerging computational paradigms are changing Social Computing phenomena. A major challenge of Social Computing is the management of resulting large amounts of data. A new Big Data industry is growing twice as fast as the software industry as a whole. A recent Gartner report predicts that enterprise and communication networks data will increase by 650% over the next five years. Data management is so strategic to the future of economic relations at global scale, that software leading companies like Oracle, IBM, Microsoft, and SAP have been acquiring firms specialized in data management and analytics, understanding the need to make better sense of the massive data sets at their disposal — data sets that can include computer log files, social networking feeds, digital video or audio. Petabytes of data are useless if no one can make sense of it. A new generation of data scientists, aiming to interpret loosely structured large scale data, should understand mathematics, statistics, and natural language processing, but also how to display and navigate through raw information. NESS will be attentive to these new challenges, but also new opportunities.

Part 2 – Position papers from a debate on macro policy

2.1 A manifesto for economic sense (Paul Krugman and Richard Layard)

More than four years after the financial crisis began, the world's major advanced economies remain deeply depressed, in a scene all too reminiscent of the 1930s. And the reason is simple: we are relying on the same ideas that governed policy in the 1930s. These ideas, long since disproved, involve profound errors both about the causes of the crisis, its nature, and the appropriate response.

These errors have taken deep root in public consciousness and provide the public support for the excessive austerity of current fiscal policies in many countries. So the time is ripe for a Manifesto in which mainstream economists offer the public a more evidence-based analysis of our problems.

The causes. Many policy makers insist that the crisis was caused by irresponsible public borrowing. With very few exceptions – other than Greece – this is false. Instead, the conditions for crisis were created by excessive *private sector* borrowing and lending, including by over-leveraged banks. The collapse of this bubble led to massive falls in output and thus in tax revenue. So the large government deficits we see today are a consequence of the crisis, not its cause.

The nature of the crisis. When real estate bubbles on both sides of the Atlantic burst, many parts of the private sector slashed spending in an attempt to pay down past debts. This was a rational response on the part of individuals, but – just like the similar response of debtors in the 1930s – it has proved collectively self-defeating, because one person's spending is another person's income. The result of the spending collapse has been an economic depression that has worsened the public debt.

The appropriate response. At a time when the private sector is engaged in a collective effort to spend less, public policy should act as a stabilizing force, attempting to sustain spending. At the very least we should not be making things worse by big cuts in government spending or big increases in tax rates on ordinary people. Unfortunately, that's exactly what many governments are now doing.

The big mistake. After responding well in the first, acute phase of the economic crisis, conventional policy wisdom took a wrong turn – focusing on government deficits, which are mainly the result of a crisis-induced plunge in revenue, and arguing that the public sector should attempt to reduce its debts in tandem with the private sector. As a result, instead of playing a stabilizing role, fiscal policy has ended up reinforcing the dampening effects of private-sector spending cuts.

In the face of a less severe shock, monetary policy could take up the slack. But with interest rates close to zero, monetary policy – while it should do all it can – cannot do the whole job. There must of course be a medium-term plan for reducing the government deficit. But if this is too front-loaded it can easily be self-defeating by aborting the recovery. A key priority now is to reduce unemployment, before it becomes endemic, making recovery and future deficit reduction even more difficult.

How do those who support present policies answer the argument we have just made? They use two quite different arguments in support of their case.

The confidence argument. Their first argument is that government deficits will raise interest rates and thus prevent recovery. By contrast, they argue, austerity will increase confidence and thus encourage recovery.

But there is no evidence at all in favour of this argument. First, despite exceptionally high deficits, interest rates today are unprecedentedly low in all major countries where there is a normally functioning central bank. This is true even in Japan where the government debt now exceeds 200% of annual GDP; and past downgrades by the rating agencies here have had no effect on Japanese interest rates. Interest rates are only high in some Euro countries, because the ECB is not allowed to act as lender of last resort to the government. Elsewhere the central bank can always, if needed, fund the deficit, leaving the bond market unaffected.

Moreover past experience includes no relevant case where budget cuts have actually generated increased economic activity. The IMF has studied 173 cases of budget cuts in individual countries and found that the consistent result is economic contraction. In the handful of cases in which fiscal consolidation was followed by growth, the main channels were a currency depreciation against a strong world market, not a current possibility. The lesson of the IMF's study is clear – budget cuts retard recovery. And that is what is happening now – the countries with the biggest budget cuts have experienced the biggest falls in output.

For the truth is, as we can now see, that budget cuts do not inspire business confidence. Companies will only invest when they can foresee enough customers with enough income to spend. Austerity discourages investment.

So there is massive evidence against the confidence argument; all the alleged evidence in favor of the doctrine has evaporated on closer examination.

The structural argument. A second argument against expanding demand is that output is in fact constrained on the supply side – by structural imbalances. If this theory were right, however, at least some parts of our economies ought to be at full stretch, and so should some occupations. But in most countries that is just not the case. Every major sector of our economies is struggling, and every occupation has higher unemployment than usual. So the problem must be a general lack of spending and demand.

In the 1930s the same structural argument was used against proactive spending policies in the U.S. But as spending rose between 1940 and 1942, output rose by 20%. So the problem in the 1930s, as now, was a shortage of demand not of supply.

As a result of their mistaken ideas, many Western policy-makers are inflicting massive suffering on their peoples. But the ideas they espouse about how to handle recessions were rejected by nearly all economists after the disasters of the 1930s, and for the following forty years or so the West enjoyed an unparalleled period of economic stability and low unemployment. It is tragic that in recent years the old ideas have again taken root. But we can no longer accept a situation where mistaken fears of higher interest rates weigh more highly with policy-makers than the horrors of mass unemployment.

Better policies will differ between countries and need detailed debate. But they must be based on a correct analysis of the problem. We therefore urge all economists and others who agree with the broad thrust of this Manifesto to register their agreement at www.manifestoforeconomicsense.org, and to publicly argue the case for a sounder approach. The whole world suffers when men and women are silent about what they know is wrong.

2.2 Sense and nonsense in macro policy (Bridget Rosewell, Stephen King, Paul Ormerod)

Is this the 1930s? Indubitably not. Output has not fallen by a third, and unemployment is not at 20%. Money supply has not crashed. There has been no deflation and no nasty debt-deflation downward spiral. In the US, output has now recovered to pre-recession levels as has employment in the UK. The policy response has prevented wholesale collapse and, four years on, the world economy is still growing. The claim that the ideas behind policy at the moment are the same as in the 1930s is just not true.

Krugman and Layard also claim that these ideas are ‘long disproved’, citing an IMF study on the size of the fiscal multiplier. On this particular study, Chris Giles in the Financial Times has shown that the multiplier estimates in this are large only because of the influence of two countries. But, much more generally other studies show a different result. Robert Barro, also a Nobel Prize winner, has published work showing that the multiplier is low. There are many such studies, and the broad range suggests that fiscal policy is not very effective in stimulating output. This is shown in a recent major survey of these estimates in an American Economics Association journal.

In both the global financial crises of the past 100 years, the 1930s and the 2000s, public sector deficits and debt rose sharply. And each time, both the personal and corporate sectors raised their savings rates sharply in response. Higher debt implies higher future interest payments and hence higher taxes. Both then and now, the private sector saved more to make provision for this. A deliberate increase in the public deficit runs the risk that any impact it might have will simply be offset by additional private sector saving to meet the implied tax liabilities. In contrast, a sensible medium term deficit reduction plan is likely to pay dividends in the form of greater private sector confidence and willingness to spend

The UK is amongst the most indebted countries in the world. Taking public and private debt together it has reached 250 per cent of GDP. Taking public debt alone, the picture is not as dramatic, though it is not so long ago that a limit of 40 per cent was thought desirable. It is now 80 per cent and risking a tipping point. Reinhart and Rogoff, the latter a former Chief Economist to the IMF, surveyed world financial crises over the last 200 years and more. They show that when the debt to GDP ratio gets to 90 or 100 per cent, the risk of a loss of confidence in the markets rises sharply. The UK is very close to that point now.

America is in a unique position. As the world’s imperial power and supplier of the world’s reserve currency, the United States can get away with things which others simply cannot. But even here, more public borrowing is not without problems. When Roosevelt came to power, he inherited a healthy fiscal position and was able to increase the deficit from 2 per cent of GDP to 9 per cent. The US deficit today is already at 9 per cent. We can see the devastating impacts of high interest rates, due to a loss of confidence, in the economies of Southern Europe today. Why take the risk in the UK?

Has the huge debt burden that has already been accumulated actually produced profitable and productive activity? And will just doing more of it do any better? When the hole is as deep as this, surely it is better to stop digging. Where are the productive assets which match this level of liability? The short answer is that they don’t exist. People borrowed to drive up property prices of both residential and commercial property. That is still stuck on the balance sheet and somehow has to be written off, or inflated away.

In the absence of offsetting higher interest rates, inflation reduces the value of the debt to a

point where it becomes manageable and it begins to make sense to borrow again, as the debt burden and the interest burden becomes tolerable. Deleveraging has to happen across the whole economy.

QE appears to have become a way of moderating this process by replacing private debt as deleveraging occurs, with public debt. This only supports the mistaken belief that all that investment was productive. Putting new straw on top of rotten straw is always a mistake and leaves banks' balance sheets still bloated. QE simply makes it easier for governments to carry on borrowing without having to address the underlying misallocation of capital.

High levels of debt can only be sustained if the borrowing has been used to create investment which will pay back. If not, some way will have to be found to make endless interest payments, even if the debt stays the same. Such interest payments can only be found by reducing benefits (for example, pensions) or reducing disposable incomes. Higher taxes are one option. In an international context, another option is a fall in the exchange rate. In theory, this enables the domestic economy to "rebalance", diverting resources way from consumption towards investment. But it is no more than a stealthy default to foreign creditors – in their own currencies, sterling-denominated assets will now be worth less – and a hidden tax on domestic income: sterling's 2008 decline, after all, only raised inflation, leading to a severe reduction in spending power. It is certainly not a free lunch.

Balance sheets matter. Debt has to be balanced by assets, whether public or private. The UK has too high a level of private debt unmatched by income producing assets. It has a rising level of public debt matched largely by a shrinking taxable capacity. This is why we are in a bind. Adding to the debt – i.e. running deficits – in these circumstances is hitting productive potential by failing to make the necessary adjustments and write-downs to the balance sheet.

Such a choice is as much political as it is economic. Japan chose to live with ever-rising levels of government debt but, as Ben Bernanke wrote in 2002, "politicians, economists, businesspeople, and the general public in Japan have sharply disagreed about competing proposals for reform. In the resulting political deadlock, strong policy actions are discouraged, and cooperation among policymakers is difficult to achieve". Living with high debt is all very well but Japan ended up with what became known as the Lost Decade.

There is no quick fix. Increases in the public sector deficit carry three serious risks. First, that any impact will simply be offset by increased private saving. Second, that long term interest rates will go to 7 or 8 per cent and lead to the debt-deflation spiral we can see in Greece and which the UK has managed to avoid. Third, that we could be faced with a sterling collapse. The future is inherently uncertain and we might be lucky. None of them might happen. But all three could, the risks are not independent, particularly the latter two.

We have become stimulus addicts, looking for the next shot to solve our problems painlessly and without effort. Krugman and Layard argue that we must spend now to prevent contraction. This is outdated. Now we must aim to balance spending with productive investment in real assets to produce future growth. Simply to say spend, spend, spend is profligacy on a grand scale and plays havoc with our children's future.

Part 3 – Statements by the participants of the Grand Challenges meeting

3.1 Rich Colbaugh (Sandia National Laboratories, Albuquerque, NM USA), Kristin Glass (New Mexico Institute of Mining and Technology, Socorro, NM USA)

Non-Equilibrium Social Science emphasizes dynamical phenomena, for instance the way political movements emerge and evolve or financial markets (actually) function. From a practical point of view, perhaps the most compelling reason to study social dynamics is to learn enough to be able to form useful predictions; however, in many social science domains, prediction is only a peripheral concern. To cite one example, in political science many scholars see prediction as inferior to explanation. Phil Schrod, former President of the Society for Political Methodology, recently suggested these researchers are reasoning as follows [Schrod 2010]:

- existing political science models are nearly worthless for prediction;
- political science researchers are scientists of unparalleled intellect and vision;
- therefore scientific models do not need to be predictive.

Similar perspectives exist in many other areas of social science.

We propose that predictive social science represents an exciting and crucially important Grand Challenge for NESS. Prediction occupies a central place in any discussion of what it means to be scientific. Moreover, the capacity to make prediction has proved tremendously useful in the physical and engineering sciences, and is viewed as the “holy grail” among practitioners in social science-based domains such as economics, politics, human health, and national security. It must be admitted, though, that existing prediction methods often perform poorly, and it is tempting to conclude that this lack of success is a consequence of some fundamental lack of predictability on the part of humans.

Recent research suggests that the failure of standard prediction methods does not indicate an absence of human predictability but instead reflects fundamental methodological flaws, for instance a misunderstanding of which features of social dynamics actually possess predictive power. A review of some of this work is provided in [Colbaugh/Glass 2012], and here we offer an example which is illustrative of one of the basic ideas. Consider the problem of predicting whether a new idea or innovation will “go viral” or will instead quickly dissipate. Conventional approaches to this problem focus the analysis on “intrinsic” attributes, such as the quality of the innovation. Recent findings call into question this intuitively plausible strategy and indicate that, when individuals are influenced by the actions of others, it may not be possible to obtain reliable predictions using methods which consider intrinsics alone; instead, it may be necessary to incorporate aspects of social influence into the prediction process. Indeed, algorithms which employ even simple and indirect measures of social influence, like the early network dynamics of memes and narratives, can produce accurate forecasts for a broad array of social phenomena (e.g., adoption of innovations, political and social movements, markets, epidemics, and emergence of various threats).

While the outlines of a scientifically-grounded predictive social science are still coming into focus, we propose that any such framework should include certain elements, such as:

- theoretical and empirical methods for assessing predictability of social dynamics,

NESS Deliverable D7.1: NESS in real world policy and modelling

including techniques for identifying which measurables (if any) possess predictive power;

- methods for gathering high-quality data, especially high-temporal-resolution data (e.g., sensors, algorithms for “mining” Web sources, techniques for conducting online experiments);
- prediction methods which go beyond regression models (e.g., techniques which combine machine learning with social science models, approaches which explicitly integrate the problem formulation and predictive modeling steps).

3.2 Matthew Cook (Design Group, Open University, Milton Keynes, UK)

My research interests are in the interlinked areas of planning, design and sustainability. While I do not believe that these can be reduced to the social, I study them as such to generate novel and useful insights. My research draws on various methods such as ethnography to understand how planning and design processes unfold and discourse analysis to unpack planning and design undertaken in the name of for example, sustainability to identify rhetorically implied orderings and ask, is this what we want? I am also increasingly interested in understanding social processes that constitute design, planning and sustainability, as complex systems. I have drawn on the work of Niklas Luhmann to understand self organizing social processes as autopoiesis and notions of complex adaptive systems (CAS) more generally, to understand spatial development and planning practices.

The notion that complexity science provides a useful way of understanding and planning the spatial is the subject of a growing literature. Although traditionally used to model spatial development, recently such ideas have been used to suggest changes to spatial planning practices. Motivations for using the CAS approach in this way are manifold. On the one hand, spatial development may be increasingly complex: governments are no longer the main actor in this process but one of many; places are no longer isolated but increasingly interconnected; information flows are speeding up. On the other hand, spatial development may have always been complex but only now are requisite tools sufficiently developed to understand and plan the spatial with this in mind. Indeed, one main reason to posit the CAS approach in spatial planning is in response to the idea that somewhat surprisingly, to date it has been atemporal (De Roo, 2011). Thus a shift in planning practice is sought: from an emphasis on being – what is there; to becoming- how the spatial develops over time and the role of spatial planning policy and practices in this regard.

While the complex systems approach may make a useful contribution to understanding important aspects of contemporary life – spatial development and planning, economics and social change more generally, I suggest that we should adopt a critical scholarly stance that involves thinking about consequent management and policy actions that may be implied by these new understandings. A number of persistent challenges that have been identified in planning and other important policy areas can be identified and the utility of the CAS approach in recognizing and dealing with these is of particular interest to me. Questions that I am exploring and would like to discuss include:

- First, as we move to a complexity view with an emphasis on self organization, how do governments discharge their responsibility to protect and obtain public goods?
- Second, self organization does not mean anything goes, rather that rules may be needed. At what scales might these rules emerge and who reviews and considers who gets what?
- Third, how do complex system approaches adequately account for notions of power?
- Fourth, what is the link between complex systems and democracy? How is democratic accountability discharged in the complex system approach?
- Finally, we may conceptualise some processes as CAS but not others. What tensions might arise from the uneven application of CAS thinking?

3.3 Alan Kirman (Professor Emeritus of Economics at the University of Aix-Marseille III)

In the social sciences the main challenges that we face involve rethinking our basic perceptions of certain problems. Some ideas or visions become entrenched and it is remarkably difficult to displace them. I will just sketch a few examples where rethinking would be very helpful and at the same time I will mention a few examples of concrete problems which might become more amenable to solution as a result of such rethinking.

Interactions

In all social and economic systems the direct interaction between individuals or entities is fundamental in determining the nature of aggregate outcomes. Whilst this has long been recognised in other disciplines it is still not part of standard macroeconomic theory. As interdependence increases the nature of the system changes. One idea is that societal and economic crises are characterised by an intensification of the direct interaction between individuals.

Efficiency or Coordination

In economics there has been an overwhelming emphasis on efficiency and the characterisation of efficient states. In other disciplines the importance of the coordination between individuals and organisms who only have a very local and limited idea of their environment is analysed. In almost no activity that one can think of do we attain anything like an efficient state, in the sense that no improvement could be made. Yet too often in our models we analyse such situations. We would do better to focus on situations which are constantly evolving and where individuals with limited knowledge try to move in, what they perceive to be the right direction.

Noisy but effective systems

Social insects are often cited as examples of how limited individuals through their interaction achieve optimal results. In fact, they arrive at effective coordination, but in no usual sense do they behave optimally. As Deborah Gordon the entomologist explains, if you watch ants long enough you wind up wanting to help them. This is probably a good analogue for social and economic systems.

Self organisation

In many social sciences the idea of self organisation has been evoked, but in economics there has been a pervasive and erroneous belief that self-organisation necessarily leads to an optimal situation. This is thought of as being our heritage from Adam Smith and later authors such as Hayek. Yet we have no theoretical reasons to justify such an argument. Elsewhere, in other disciplines such as ecology this notion has been abandoned but in economics this persists and as Lord Turner the head of the U.K. Financial Services Authority said, “There was a dominant conventional wisdom that markets were always rational and self-equilibrating” We should heed some of the lessons learned in other disciplines and abandon this notion.

Two important empirical challenges

- *Crises*: We have to be able to model societies and economies in which crises are a persistent and endogenous phenomenon. We have to abandon the idea of a system on an equilibrium path which occasionally gets upset but inevitably returns to

NESS Deliverable D7.1: NESS in real world policy and modelling

equilibrium. Such a view has no theoretical foundation and is systematically refuted by the empirical evidence.

- *Inequalities*: Analysing the systematic recent increases in inequality of wealth and welfare within and between countries is a major challenge. Furthermore we have to understand to what extent this is an intrinsic feature of our systems.

3.4 Paul Ormerod (Volterra, United Kingdom)

The key empirical features of our social and economic worlds mean that the ‘rational agent’ model of economics is no longer relevant in most situations – if it ever was. We now face a vast proliferation of choice; choice of products and services which are hard to evaluate; we are connected as never before: half of humanity now lives in cities for the first time ever; the ITC revolution makes us much more connected.

We need a new ‘null model’ of agent behaviour which re-defines ‘rational’ behaviour in such a world. This will be a model based more on the principle of copying and not economically rational evaluation and selection.

The fundamental building block must be networks: who potentially influences whom, why, where and when. This applies to individuals, firms, regulators, governments – all agents. In terms of network theory, a large amount is now known about percolation or containment of behaviour on networks in which both the rules of behaviour of each node and the links which connect them are fixed.

A major challenge, which extends beyond the social sciences into the sciences more generally, is to build up a similar level of knowledge about networks which evolve, both in terms of agent behaviour (the nodes) and network structure (the links).

3.5 Bridget Rosewell (Chief Economist, Greater London Authority)

In the real world decision making is a risky and uncertain business, full of both known and unknown unknowns.

Both policy makers, business people and indeed consumers face hard choices every day. Yet the tools of analysis that we have don't handle these realities at all well. Transport models don't include the potential for accidents and generally assume that all planned trips happen regardless of crowding or congestion.

Infrastructure decisions for the long term are taken as if the future of the economy is known and as if it does not interact with other decision frameworks.

So decision makers try to incorporate the feedbacks and dynamics that they know exist in a way which is not properly incorporated into our understanding of economics or social science.

The grand challenge is to develop models which can capture the non equilibrium impacts of feedbacks and change. But they must also be transparent and understandable to decision makers, which is a grander challenge still.

3.6 Flaminio Squazzoni (GECS-Research Group on Experimental and Computational Sociology, University of Brescia, Italy)

In my talk, I shall discuss two main sources of non-equilibrium behaviour of socio-economic systems that we observed in our recent experimental and computational work (e.g., Boero et al. 2010; Bravo, Squazzoni and Boero 2012; Bravo, Squazzoni and Takacs 2012):

- (i) the role of reactive, emotional behaviour of individuals even in ‘cold’ interaction where rationality should prevail,
- (ii) the importance of the interaction structure, e.g., who interacts with whom, in influencing individual behaviour.

These results indicate that although non-equilibrium behaviour of socio-economic systems depends on the increasing interdependence of various sectors and domains (e.g., ICT, economy and society), which is a macro feature of our globalised societies, the explanation of this has to be found in micro and local details that it is hard to know in advance and requires experimental observation and computational modelling. This makes prediction of social outcomes difficult and even less relevant than understanding and management of complex systems for 21st Century policy making.

References

- Boero, R., Bravo, G., Castellani, M., Squazzoni F. (2010) Why Bother with What Others Tell You? An Experimental Data-Driven Agent-Based Model. JASSS 13 (3) 6.
- Bravo, G., Squazzoni, F., Boero, R.. (2012) Trust and Partner Selection in Dynamic Networks. An Experimentally Grounded Model. Social Networks, forthcoming.
- Bravo, G., Squazzoni, F., Takacs, K. (2012) Intermediaries in Trust. An Experimental Study on Incentives and Social Norms. Carlo Alberto Notebooks, 240, www.carloalberto.org.

3.7 Impressions from the workshop on Grand Challenges in non-equilibrium social science (Bassel Tarbush, University of Oxford)

I should start by noting that the research group's name is rather confusing. Neither "non-equilibrium" social science nor "equilibrium" social science are well-defined fields. While caricaturing slightly, the group seemed to equate all of social science with economics, and to view economics as a field that has lost its bearings because it cannot free itself from "equilibrium" notions which it inherited during its mathematical development since the 1950s.

"Equilibrium", of course, is a vague term that was used to refer to any economic model that uses the notion, but was mostly used in reference to equilibrium models of the market. These models are indeed ubiquitous in neo-classical economics, and it is their failure in accounting for phenomena like the financial crisis of 2008 that has spurred the creation of research groups like this one or like the Institute for New Economic Thinking.

However, one must look only at recent developments, especially those in evolutionary game theory since the mid-90s, to see that even mainstream economics has adopted models that are decidedly not pure "equilibrium" models. And, in fact, several participants did express an interest in greater exposure to current ideas in the social sciences, and some conceded that even "equilibrium" models can be useful for policy when used in the right circumstances.

Using the terminology employed at the conference, I will attempt to outline what were considered to be some the most pressing issues in theoretical modelling. Current equilibrium models of the market typically view the economy as comprising of a representative household, a representative firm, and possibly a collection of other institutions, each represented by a single agent that is supposed to mimic the behaviour of the entire sector. Each representative agent behaves optimally, and the interactions across the agents happens indirectly via a price mechanism. The economy usually fluctuates within some range around the equilibrium price. Thus the system exhibits relatively stable dynamics throughout. Large discontinuous shifts—such as the financial crisis—are frequently represented by some exogenous shock to the system.

A large portion of the discussion at the conference revolved around modifying the main building blocks of such models. Firstly, it was thought that the representative agent paradigm ought to be revised. Alan Kirman presented a neat illustration of the importance of such a revision. Bees flap their wings when the temperature rises to fan out their hive. In reality, the wings of each bee flap at a constant rate. Each bee has, however, a different temperature threshold that induces it to start flapping its wings. If this situation were modelled by a representative bee, then we would have a single bee that flapped its wings faster as the temperature rose. That is simply not how bees behave, and presumably modelling the environment of the hive using a representative bee and using multiple bees would produce different results.

Secondly, it was argued that the entire notion of "optimising agents" should be replaced. An agent can instead be thought of as an algorithm that responds to its environment. Naturally, the optimising agent is a special case of this, but the proposed approach does not require the agent to be optimising, and the approach can easily put a larger focus on the interactions across agents rather than on the agents themselves. For example, copying behaviour can easily be made default. Alan Kirman's analysis of the Marseille fish market is a notable example of models employing these ideas. Every consumer simply finds a seller that he/she

NESS Deliverable D7.1: NESS in real world policy and modelling

seems to like, and returns to the same seller every time, without bothering to look around for better alternatives. The agents are clearly not optimising, and the results of this model do break with what would be obtained traditionally. Namely, the market becomes characterised by a distribution of prices, rather than by a single price for which the market clears.

Finally, a call was made to all members of the conference to develop models in which the economy is characterised by stable periods punctuated by large endogenous shocks. Such models, with inherent instability, would provide us with a better understanding of infrequent, but large and potentially devastating shocks, such as the latest financial crisis. Some time was also spent discussing the implications that systems with inherent instability would have for policy decisions. Indeed, reducing instability in such systems may involve new trade-offs. I believe this was largely inspired by a paper by Brock, Hommes and Wagener (2009) that uses an agent-based model to show that increasing the number of hedging instruments can lead to greater instability in an economy.

3.8 Magda Roszczynska-Kurasinska (University of Warsaw)

Other issues that were discussed during the workshop referred to the added value of non-equilibrium social sciences and how the new approach can reach a broader audience located outside the complexity field. Many of the speakers expressed a common concern: despite the growing body of evidence that equilibrium based models fail to reflect the complexity of economic behaviour, these models remain the prevalent tools for the study of social phenomena. Equilibrium based models serve as a reference point in the development of new policies which, when implemented, may not always achieve the intended effect.

In this regard, two main questions of the workshop were defined. Which new approaches to social science are most scientifically promising? Second, what should be the strategy of making these new approaches accessible for policy makers? For me, attempting to deal with the problem of heterogeneity of agents and any interaction between them that may cause a non-additive effect would represent the evident added value of non-equilibrium social science. The simplification of agents' behaviour (often done through concepts like utility function, maximisation of profits, rationality, and optimisation) unduly restricts many economic models.

The incorporation of complexity into formal social models would not enhance only our understanding of the social systems, but would also influence one of the most important aspects of economic models—predictability. This feature has profound value, especially for companies and policy makers who need to know which decision they should make to maximise chances of driving the system in a desirable direction. For them it is not enough to understand the system; they need to understand how change will influence the system. It seemed to me, however, that there was no clear consensus about what stood behind the word predictability. Can we expect non-equilibrium models to indicate the exact timing of emerging events in the future? I think that in the case of this approach, prediction can be understood, rather, as an identification of the boundaries of systems. With non-equilibrium based models, it becomes possible to explore the future consequences of current changes and to model the most probable outcomes of chosen interventions. It is not possible to precisely know the future, but it is possible to shrink the space of all possible outcomes to a few of the most realistic outcomes.

I found an illustration of the taxonomy of modelling, given by Jamie Macintosh, convincing. If we took all of the social phenomena of interest to scientific study and placed them in a space described by the variable of the diversity of agents and the variable of the possibility of interactions, it would appear that the box labelled 'low variability and lack of interaction between agents' covers only a small part of the whole space. In the remaining part of the space, both the variability and interactions are quite significant, and neither can be neglected. The classical models of social phenomena are relevant only for the first box and they should not be utilised for studying the remaining phenomena in the space.

Applying classical models to phenomena for which both variability and interactions are high, we can achieve interesting, albeit false, results that can lead to faulty reasoning and the creation of flawed policy. In other words, non-equilibrium modelling does not imply that equilibrium modelling is inherently faulty, but, rather, it suggests that equilibrium modelling is suitable for only some cases. There is no one approach in the social sciences that is suitable for all cases; some problems require simple solutions, others more difficult solutions.

Although there is, however, a need for non-equilibrium social science, it seems to remain a niche field. I think that the approach of non-equilibrium social science may raise the fear that

the incorporation of complexity into models will make the models too difficult to understand and be of use. It also might be erroneously believed that the only conclusion from it will be ‘things are complicated’. This fear is, however, unfounded. Complex does not mean complicated. Complicated models are those that are built from huge number of elements, while complex models deal with emerging effects of interacting elements of a system in which the behaviour of the system is something more than sum of its parts.

Bridget Rosewell claimed that one of the key elements in working with the end user of the model, (e.g. a policy maker) is developing a mutual understanding. With well defined measures, highly complex models produce results that can be comprehensible and easily used by policy makers.

But will this help non-equilibrium social science to reach the broader audience? According to Jeffrey Johnson, a new education policy could play a vital role in disseminating and popularising the field. If the existing curricula offered by universities is extended, through courses dealing with notions like uncertainty of prediction, heterogeneity of agents, and complexity more in depth, then universities will foster a deeper understanding among future policy makers of the different methods of social science and their drawbacks and advantages. This would also help these future leaders to use models derived from non-equilibrium social science when such a need arises. When it comes to education, it is also important to remember the modellers behind the social sciences. It is critical to increase their awareness of the environment in which policy makers draft their decisions and of policy makers’ needs regarding models and analysis. Fostering mutual understanding between modellers and policy makers should be an area of greater consideration.