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Editorial

Economics, innovation and history: Perspectives in honour of Nick von Tunzelmann☆

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ABSTRACT

This introductory article raises a methodological challenge for scholars of technical change and innovation, on the one hand, and historians of technical change, on the other. We ask to what extent have economists and historians of technical change engaged in cross-fertilisation with regards to methods and the identification of relevant questions. We then provide an overview on the use and methods of history within the field of Economics of Technical Change and Innovation Studies (ETIS), which is traditionally considered as 'history-friendly'. We locate the work and intellectual heritage of Nick von Tunzelmann among that of a small group of scholars in which history and economics of technical change have cohabited happily. We reflect on the variety of historical methods proposed by the contributors to this special issue, who were invited to respond to the above methodological challenge. Finally, we propose a way ahead in terms of the identification of relevant questions and pertinent methodological approaches.

1. Introduction

Economics of Technical change and Innovation Studies[1] at large (ETIS from now on) is widely perceived as a history-friendly field of research (see, von Tunzelmann, 1990; Freeman and Louçã, 2001; Fagerberg et al., 2006, 2012a). The conference entitled 'Technical Change: History, Economics, Policy' was a *festschrift* in honour of Professor Nick von Tunzelmann held in 2010 at SPRU, at the University of Sussex, the pioneering centre of ETIS research where Nick von Tunzelmann spent some thirty years of his academic career. Those participating in the conference were asked to provide historically oriented papers on technology and innovation. Interestingly, the response included articles based on a variety of methods of 'using' history. Some used long-established archives and presented findings as narrative accounts, others referred to historical data to empirically test hypotheses, and still others examined recent and contemporary phenomena using narrative representations. However, while the contributing scholars consider themselves by and large as innovation scholars, very few of them would consider themselves as historians. The range of approaches and the sense of belonging to a particular disciplinary community – history of technical change and innovation – vary widely among these scholars.

When we invited contributions to this special issue, we posed a two-fold question:

(i) Why and how do economists of technical change and innovation scholars use history?
(ii) How do historians of technical change interact with ETIS scholars, if at all?

The resulting special issue is an opportunity to reflect and (re)consider the role, methods and use of history in the ETIS field, which somewhat resonates with the evolution of economics and economic history as disciplines over the past century.

Economics and economic history have debated their turbulent relationship at times by serenely accepting their distinctiveness, at other times divided by the assertion of a supposed superior common quantitative method, dating back to the advent of cliometrics in the late 1950s[2], which has not been free from harsh critiques (for an interesting assessment of this evolution, see Freeman and Louçã, 2001). More recently, an *American Economic Review* (AER) special section in 1985, with contributions from Solow, Arrow and David among others, helped clarify the ways in which history was used

☆ This article is the outcome of numerous fruitful and lively discussions on the framing of the initial challenge to contributors and our editorial 'position note'. We would like to thank Ove Grandstrand, Ismael Rafols, Johan Schot, Ed Steinmueller and Nick von Tunzelmann, for invaluable inputs on earlier versions. Ben Martin has been much appreciated in his role as Lead Editor for this Special Issue. Neither he nor the others listed here are responsible for any remaining errors and omissions.

[1] The ETIS field in our definition reflects an historical evolution itself. It includes both the original generations of economists of technical change, and later developments of the field of innovation studies at large, which also includes scholars of other disciplines with no explicit economic orientation.

[2] It has been claimed (see Freeman and Louçã, 2001) that the first cliometric 'manifesto' dates back to Meyer and Conrad's (1957) Journal of Economic History article on *Economic Theory, Statistical Inference and Economic History*. The cliometric method was then applied in their study of slavery in the *ante-bellum* South of the US, published the following year (Conrad and Meyer, 1958).

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by economics, and also lamented the ways in which it was not, but should have been. Lamoreaux et al. argued, in 1999, that:

> To the present day, the Business History Conference is dominated by trained historians, whereas the Economic History Association is controlled by trained economists. Despite large areas of common interest, the professional reference groups, not to mention the norms about what constitutes interesting questions, pertinent evidence, and persuasive arguments sometimes seem alarmingly different. Moreover, in the absence of a compelling new interdisciplinary effort, this divergence seems likely to endure. (Lamoreaux et al., 1999, quoted in Freeman and Louçã, 2001)

Echoing the AER special session, we called for a similar reflection upon the ETIS field and the use and methods of history within it, to honour the work and intellectual heritage of Nick von Tunzelmann. He, among those few scholars like Nathan Rosenberg, Paul David, Joel Mokyr and Deirdre McCloskey, is an 'orthodox' economic historian who has added to the 'heterodox', interdisciplinary and (then) young ETIS field.

The papers contributing to this special issue cover a representative variety of conceptual and methodological approaches to the use of history in the ETIS field. The present article reflects on the way that they address the questions above, and challenges both ETIS scholars and historians of technical change to bridge the two fields.

Before critically reviewing the individual contributions, we first question what is history and where the debate over the use of history in economics has led so far (Section 2). We then move onto how history has been used in the ETIS field, with an overview of the common intellectual roots (Section 3). We next locate Nick von Tunzelmann's academic career(s) as an historian and economist of technical change, his contributions, intellectual heritage and influence within the field (Section 4). Finally, we critically appraise each of the individual articles in the special issue (Section 5.1) and provide an *ex post* assessment of the conceptual and methodological achievements and challenges ahead for the use of history within the ETIS field (Section 5.2). Section 6 offers some concluding remarks.

2. What is history?

Before going into further detail on the role of history in the ETIS field, we should first consider history itself, what it is and how it is carried out. The Oxford English Dictionary offers the following definition of history with a capital H:

> That branch of knowledge which deals with past events, as recorded in writings or otherwise ascertained; the formal record of the past, esp. of human affairs or actions; the study of the formation and growth of communities and nations.

However, debates within the field through the late 20th century undermined this view of an authoritative and singular "formal record of the past". The various turns of the late 20th century – the linguistic turn, the feminist turn, the postmodern turn – all eroded the sense of a singular authority defining the past. Following the influential book '*What is History*' by Carr (1961), the field seemed to settle on a position where history is a continuous process of interaction between the historian and her facts. Historians strive to be reflexive, are conscious of the sources that they select and the significance that they give to them. However, even while recognizing that its narrative representation is subject to linguistic authorship, the epistemology of history is relentlessly empirical. It is generally believed that the evidence can deliver some approximation of the truth, which may be achieved through interrogating the data in a theory-testing sense.

History's relationship with the social sciences, and economics in particular, is entangled in the search for positivist science. This can be simplified to a bipolar position where narrative history either falls in and out of favour against 'scientific history' or 'economic determinism'. Hobsbawm's (1980) rejoinder to Stone (1979) on 'The Revival of Narrative', argued that there was actually more continuity to both approaches than may appear in changing fashions. For example, interests in more micro-level subjects tend towards coherent singular chronology narrative while interests in 'big why questions' tend towards structures and multi-causality. But as Hobsbawm put it: "So long as we accept that we are studying the same cosmos, the choice between microcosm and macrocosm is a matter of selecting the appropriate technique. It is significant that more historians find the microscope useful at present, but this does not necessarily mean that they reject telescopes as out of date." (1980: 7).

This metaphor of scientific instruments is germane. Gaddis (2002) argues that history is much more similar to the natural sciences than the social sciences in the way that resource and data collection iteratively interacts with problem definition. In particular, Gaddis points to the similarities with physical history as produced by astronomy, geology and evolutionary biology. Here methods typically begin with a subject phenomenon that is treated essentially as an outcome, and the research is directed towards understanding the processes that led to this outcome. Gaddis argues that historical processes and outcomes are complex, like those of astronomy and earth sciences, and so there is a high tolerance for multi-causal explanations and interdependent variables, a tolerance that is not present in much of the social sciences.

In spite of the differences between traditional history and social sciences, a succession of distinguished economists has tried to articulate the value of history to economics. For example, Solow argues in a special section of *American Economic Review* that history provides social and temporal context, which is too often forgotten in the search for a general economic model (Solow, 1985). Arrow (1985) argues there are two uses of history, firstly as empirical evidence with which to test theory, such as time-series studies, and secondly as a means of understanding conditioning of economic phenomena. Similarly to Solow, this means an appreciation of the influence of different contexts, and perhaps how the present came to be. Even contemporary cross-country comparisons, for example, can be better understood by reference to history, which can show similar (or different) 'stages' of development. Conversely, Arrow points out that historians are essentially trying to understand a particular event, and will use data and possibly social science theory for that purpose, while social science is aimed at general principles.

There are impressions that since the financial crash of 2008, attitudes in economics seem to have changed in favour of history. "Historical work has new interest and new status. Even economists, who usually have little time for history lessons, humbled perhaps by their role in recent cataclysmic events, appear to have new respect." (Humphries and Hindle, 2009: 1). This is reflected in debates in *The Economist*, with the view that "Economic history should be at the heart of the economics instruction" (Pettis, 2010, echoing Schumpeter and also Rosenberg, 2011), as we shall see in the next section.

3. History, Economics of Technical Change and Innovation Studies: tracing common intellectual roots

The ETIS field traces its intellectual heritage to Smith, Marx, the Austrian School and most importantly to Schumpeter, who tried to bridge economics and history in the early 20th century.

For Schumpeter *history* – along with *theory* and *statistics* – was an indispensable area of knowledge that should be included in the training of all economists, as he believed that history would nurture the formulation of hypotheses that lay behind economic models[3]. Schumpeter believed that economic systems were in constant flux and that innovation was the engine inside capitalism that drove it forward. History could reveal how these dynamics worked.

In his incisive discussion of the intellectual roots and agendas shared by Marx and Schumpeter, Rosenberg (2011) argues that Schumpeter greatly admired Marx's sophisticated command of history, which provided what he called the *economic interpretation of history*. As Rosenberg (2011) recalls, this emerges from Schumpeter's own account of how Marx's use of history was distinctively different from the general practice of economists of his time. In his monumental *Capitalism, Socialism and Democracy*, Schumpeter argues that while historical facts tend to enter (if at all) into economic theory as a mere illustration or verification of results, remaining therefore a "separate compartment" or a "mechanical mixture" (Schumpeter, 1976: 44),

> "(. . .) Marx's mixture is a *chemical one* [italics added]. (..) he introduced [historical facts] into the very argument that produces the results. He was the first economist of top rank to see and to teach systematically how economic theory may be turned into historical analysis and how historical narratives may be turned into *histoire raisoneé*" (Schumpeter, 1976: 44)

Interestingly for the purpose of our argument, Rosenberg (2011) claims that such a remarkable way of using history to derive economic theories – characterizing both Schumpeter and Marx – was a result of their common intellectual agenda of explaining *economic change*. The *economic interpretation of history* entails a view of economic change indissolubly linked to scientific and technical progress, responsible for changes in the forms of capitalistic production, which, in turn, affect social and incentive structures shaping individual behaviours (see Mokyr, 2010). Here is an embryo of the concept of *path-dependence* – an analytical device now firmly entrenched within the ETIS field. The legitimization of the concept of path-dependence lies in the view that Marx and Schumpeter shared, that dis-equilibrating forces inherently characterise capitalism, and these forces rather than re-equilibrating ones prevail after occasional disturbances.

The notion of path-dependence is incompatible with the Walrasian equilibrium theory that represented the orthodox background of Schumpeter and other professional economists of his time. In spite of the fact that Schumpeter argued strongly for the mathematical apparatus that became general equilibrium theory (his *theory* and *statistics*), he was also standing alone in his regard of *history* as fundamental in completing economic theory.

The roots of the ETIS field can therefore be traced in the debates sparked in the 1970s and 1980s, which included reactions to the ascent of neo-classical economic theory and its tendency to ignore or marginalise the 'time-aware' sources of influence on processes of economic change (i.e. institutions, social contexts) and to increasingly strip history away from economic thinking.

Part of these reactions included the familiar critique of neo-classical theory[4] as being fundamentally based on time-less agents, where time is 'collapsed' at the moment of market transactions, with determinants and consequences of economic choices confined to price signals and utility changes. Also the notion of causality is limited to prices and quantities, which makes choices perfectly predictable and consistent with the assumption of economic agents accessing perfect information and formulating perfectly rational choices. In this respect economic phenomena in neo-classical theory are typically under-determined with respect to the richness of processes that occur in the real world. Interestingly, as noted in von Tunzelmann (1990), the Austrian School distinguished between 'real' or historical time and 'Newtonian' time in orthodox economic models (O'Driscoll and Rizzo, 1985).

The economic history 'equivalent' of this positivistic turn is the advent of cliometrics, the 'new' economic history. The eruption of cliometrics in the discipline dates to the late 1950s and was acknowledged as the application of hypotheses of economic rationality to the study of economic and social history. This sparked an entrenched debate between the cliometric school of economic historians and those who favoured contextual factors like institutions and narrative representation. The former regarded the latter as 'old' and unscientific, while the latter felt the cliometric models were over-simplified and denuded of any context (Freeman and Louçã, 2001).

On this debate, Nick von Tunzelmann (1990) reprised Schumpeter's (1939) *Business Cycles* argument and took an original stand. He was already fully aware of the difference between heterodox and orthodox economics schools with respect to the extent to which the role of historical time was acknowledged in the former but not fully in the latter. However, time-less orthodox theories are empirically tested with statistical or econometric techniques that do require an appropriate treatment of historical time. Subtly, argues von Tunzelmann (1990), the statistical and econometric treatment of time in applied economic theory often implies that the basic assumptions of the underlying theory fail to be met. In other words, the mere empirical test – based for instance on long-run historical data – implies a treatment of time that the underlying theory does not account for.[5] Hence, in some respects, von Tunzelmann considered cliometrics as the Cinderella of the 'orthodox stepmother witch' – poisoned by her 'lunatic' assumptions

[3] It is worth here recalling Schumpeter's position from his own words (from the introduction to his History of Economic Analysis, 1954: pp. 14–21 [footnotes omitted]): 'What distinguishes the 'scientific' economist from all the other people who think, talk and write about economic topics is a command of techniques that we class under three heads: history, statistics, and 'theory'. The three together make up what we shall call Economic Analysis'. Of these fundamental fields, economic history – which issues into and includes present-day facts – is by far the most important. I wish to state right now that if, starting my work in economics afresh, I were told that I could study only one of these three but could have my choice, it would be economic history that I should choose. And this on three grounds. First, the subject matter of economics is essentially a unique process in historic time. Nobody can hope to understand the economic phenomenon of any, including the present, epoch who has not an adequate command of historical *facts* and an adequate amount of historical *sense* or what may be described as *historical experience*. Second, the historical report cannot be purely economic but must inevitably reflect also 'institutional' facts that are not purely economic: therefore facts *are* related to one another and how the various social sciences *should* be related to one another. Third, it is, I believe, the fact that most of the fundamental errors currently committed in economic analysis are due to lack of historical experience more often than to any other shortcoming of the economist's equipment.'

[4] For a recent and interesting '*Interpretive history of challenges to neo-classical economics and how they have fared*', see Mazzoleni and Nelson (2013), who review the historical roots of behavioural, institutional and evolutionary economics, the three main theoretical strands challenging neo-classical micro-economic foundations.

[5] A germane example is the attempt made by Meyer and Conrad (1957) to fit historical explanations in a stochastic process: "(. . .) explanations in a historical system can be interpreted as the estimation of probabilities of transition from one state to a succeeding state, given the initial conditions and a causal law of generalization. In that interpretation the task of the economic historian is to search out the variations in the exogenous variables, that is, to add to the set of empirically realized independent conditions" (Meyer and Conrad, 1957: 530–1). (1977: 433–4) put this in perspective by admitting that "the best we can do is to formulate explanatory generalizations with an error term", which in our view is the epistemological equivalent to Abramovitz's (1956) characterization of the Solowian residual as a "measure of our ignorance".

(McCloskey, 1978) – and waiting to be rescued by the 'heterodox Prince Charming[6]'.

For its part, the ETIS field inherited the Schumpeterian legacy through influential scholars such as Nelson and Winter (in spite of Schumpeter's rejection of explicit evolutionary modelling), Nathan Rosenberg for all his career, the late Chris Freeman and obviously the work of Nick von Tunzelmann along with the large number of scholars who now represent the ETIS 'invisible college' (Fagerberg and Verspagen, 2009; Fagerberg et al., 2012a), and include some of the contributors to this special issue. All these appreciated the importance of historical contextualisation, the role of institutions, the effortful accumulation of technical knowledge and the influence of path-dependency on economic development (notably, David's, 1985 contribution on the latter). They sought to understand differences among firms, sectors and countries, and how these affected technical change, paradigm shifts and structural changes of economies, rather more than to analyse historical data to establish general economic principles. This strongly resonates with the intellectual roots that Rosenberg (2011) has traced in Schumpeter and Marx, both in terms of intellectual agenda and the 'chemical mix' between history and economics, which leads to an *economic interpretation of history*.

After tracing the intellectual roots of the ETIS field and the use of history within it, let us now attempt to provide a roadmap of the methodological approaches to the use of history in addressing ETIS-relevant questions. Broadly speaking, there are perhaps half a dozen applications of history within the ETIS field. The first three of these adapt Arrow (1985) on the uses of history within economics, including the role of cliometrics. The remaining ones represent more recent applications as used in subfields like business history.

(1) *Modelling micro-behaviour and macro-patterns*. ETIS has produced well-known models of micro-behaviours, which have led to macro historical patterns. The QWERTY story is a much cited example (David, 1985); models based on increasing returns assumptions and diffusion modelling permeate many of the technological trajectories shifts analysed within ETIS. An important application here is forecasting.
(2) *History as data*. While not necessarily presented as a narrative, testing hypotheses on historical data in the vein of cliometrics is certainly an application of history. One benefit is to show how contemporaneous phenomena are not necessarily new, for example Mowery's (2009) study on how open innovation was a common mode of operation in the first half of the twentieth century.
(3) *Conditioning general theories*. Examining the past occurrence of a phenomenon helps to establish differences between 'semi-autonomous' variables and endogenous ones, which may then guide conjectures on causal directions. For example, observing early stages of industrialisation in Northern or Southern Europe may inform a study of what is occurring in China today. There may be similarities in the stages of development in the past and the present, but equally finding differences may be as valuable in refining theories and understanding how geographical, cultural and institutional conditions produce differing outcomes.
(4) *Understanding long-term structural changes of economic systems*. Perhaps the primary reason for the neo-Schumpeterian proclivity for history is that it shows dynamics. Scholars can reveal structural patterns of growth and decline by analysing long time-periods and drawing comparisons between periods as well as understanding the development of national and regional systems.
(5) *Micro-level 'process studies'* (Van de Ven, 2007) of organizations exploring how change occurs. The Chandlerian influence is important in the case-study method employed by many researchers in business history, and is widely used in management studies, including technology and innovation management. Law also relies extensively on case studies, which may have ETIS implications, such as Intellectual Property or Competition Policy law, that frequently involve innovation and its effects.
(6) *Prescribing for contemporary contexts*. Normative studies are important in ETIS as research is often aimed at making recommendations to policy-makers in government or to managers and engineers in firms. Researchers engaged in this use evidence from the past to build cases for specific interventions or to provide inspiration for new initiatives.

4. Nick von Tunzelmann: the historian and the ETIS scholar

As a scholar, Professor Nick von Tunzelmann is an interesting 'boundary subject,' bridging history and innovation studies. It has been suggested that he had two careers: the first as an economic historian concerned with the classical questions of that field, and the second in the contested interdisciplinary field of Innovation Studies (Fagerberg et al., 2012b). He began his career in economic history, in Canterbury, New Zealand and then went on to Oxford and Cambridge, where he was a Fellow of St. John's College from 1970 to 1984. His doctorate at Cambridge and much of his early work focused on the contribution of the steam engine to industrialisation. This work is ostensibly 'mainstream' economic history. In 1984 he moved to SPRU at the University of Sussex and began what may be described as his second career, where he remains to the present day, now as Emeritus Professor.

Nick von Tunzelmann has called his time at SPRU a 'reincarnation' (1995a: xiii), but was it really such a deviation? His work on steam power clearly stressed the central role of a new technology that diffused throughout the growing industrial economy and became ubiquitous. This work was later seen as a precursor to the more recent body of research on 'general purpose technologies' that has become a central theme in the ETIS field (von Tunzelmann, 1978; Craft, 1977; Bruland and Smith, 2013). His careful empirical approach to British industrialisation concluded that much of the popular emphasis on steam as the driving economic force was 'hot air'. Similarly he pursued core economic history themes such as his quantitative studies of the relationships between standards of living or inequality and economic growth (von Tunzelmann, 1979), firstly comparing these under differing political systems in the 1970s and 1980s, and later revisiting the issue, this time in an innovation context with research on the relationships between technological change and rising skill inequality in the late 1990s. He maintained interests and methodological approaches throughout 'both' careers, producing work that influenced the development of each community.

It is perhaps the boundary-spanning nature of his work that has been its most valuable contribution. He became the 'go-to' scholar for technological innovation for the *Cambridge Economic History of Britain* over the course of its three editions, analysing the sources and effects of technological change for the UK economy in the Industrial Revolution and interwar (1st edition), 19th century (2nd edition) and late 20th century (3rd edition). Much of his work added nuance to central concepts that had become conventional wisdom, such as the role of 'demand pull', where he turned attention to the effects of 'time-saving technical change' in the organization of factories (von Tunzelmann, 1995b). 'Complexity'

[6] We will argue below that over 20 years since von Tunzelmann (1990), this is still one of the main methodological challenges that has yet to be addressed in the ongoing effort to get ETIS scholars and historians of technology to interact fruitfully.

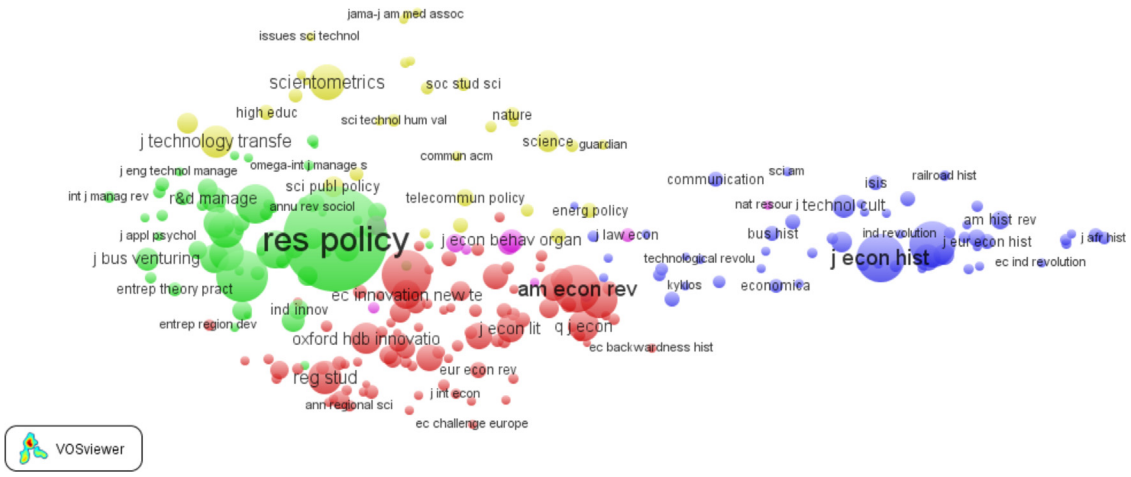

Fig. 1. Journals of articles citing Nick von Tunzelmann's publications.
Source: Thomson Reuters Web of Science; colour coding denotes co-citation of the journals in the citing articles

and 'capabilities' are also key concepts that have received great attention and which Nick has addressed at micro, meso and macro levels, clarifying distinctions and interactions between competences and dynamic capabilities (von Tunzelmann and Wang, 2000, 2003, 2007; Fujimoto et al., 2000).

This multi-level approach was also applied to the behaviour of interacting 'systems of production' and 'network alignment' (von Tunzelmann, 2002; Dyker and von Tunzelmann, 2003), contextualised in global and long-term perspectives. The interest in long-term phenomena again owes much to his grounding in history and stimulated his work on the links between technological changes and organizational or governance change over the long term and through 'technological revolutions' (von Tunzelmann, 1997, 2003; von Tunzelmann et al., 2008). He did not favour the popular Kondratieff 50-year wave, preferring instalments of 100 years as units of long-run empirical analysis, echoing his results on the protracted effects of steam. Although known for his work on steam power, he worked on a broad range of industries and technologies including textiles, food-processing, biotechnology, electronics and IT and telemedicine, which helped him to understand the patterns of technology development and application across sectors and the nature of 'technological paradigms', 'trajectories' and heuristics (von Tunzelmann et al., 2008). One of his most cited publications is the chapter on 'Innovation in 'Low-Tech' Industries' with Virginia Acha, in the *Oxford Handbook of Innovation* (von Tunzelmann and Acha, 2005). Much of the diversity of these studies stems from the wide-ranging interests of his doctoral students, of whom there were over 100 and who hailed from many countries. He wrote:

> It is to all my colleagues in SPRU and above all to my doctoral and masters students, who have taught me and forced me to think about so much, that my deepest intellectual debts are owed. (1995a: xiv)

So it can be said that there was continuity, rather than discontinuity in terms of his research interests, methods and orientation. In his 'first life' he was interested in the economic effects of technology and innovation over time, and this continued in his second life. His historical training and knowledge base informed his later innovation work. Conversely he was able to draw on the range of innovation theories and concepts, for example recommending Schumpeterian and evolutionary theories in his piece on 'Cliometrics and Technology' (von Tunzelmann, 1990).

Another way of assessing his intellectual location is to visualize the journals co-cited with his work. Fig. 1 shows broadly four clusters of journals that are cited alongside the von Tunzelmann oeuvre. These are clustered by similarity in their list of overall citations.[7] It shows that his work is cited alongside innovation journals, with *Research Policy* at the centre; economics and economic geography journals; a cluster of journals related to science and science policy; but out to the right there is a substantial cluster of economic history journals. The historical reach is an unusual profile for an innovation studies scholar and much of this reach will be invisible since the source of this bibliometric data, the Thomson Reuters Web of Science, holds limited information on referencing within monographs and edited book collections. Since history as a field generally has a proclivity to publish in the book form and less so in journals, the data available here is biased and incomplete where Nick's and other historians' work is concerned. In spite of this incompleteness we can observe that distinctive scholarly communities have made use of his work, and that economic history (at the right hand side of Fig. 1) is the one most distant from the others, so supporting the 'two lives' hypothesis.

Fig. 2 shows a co-citation map of his most cited publications (i.e. it shows his publications among the corpus of references cited by publications citing von Tunzelmann). It shows a grouping of historical and economic history citations adjacent to his important 1978 book, *Steam Power and British Industrialization to 1860*. Another significant cluster surrounds his highly cited chapter in the *Oxford Handbook of Innovation* with archetypal innovation scholars like Freeman and Nelson. He also has highly cited publications in a science policy cluster and a technology and innovation management cluster. These clusters show that these are largely distinctive academic communities, which have used his work, even if there are some individuals, like him, who traverse innovation studies and history. There is a tendency for each community to gravitate to different publications representing the 'two lives'. Historians tended to cite The *Steam Power* book but references to his early work continued throughout his career showing a lasting impact, even as he was operating in a new and different field. We might have hoped for rather more cross-citation between history and ETIS, but it shows the contributions that he has made to two fields and serves as an exemplar in this ongoing agenda.

[7] For this visualization we use the standard mapping and clustering algorithms of the freely available computer program VOSviewer (www.vosviewer.com).

Fig. 2. Co-citation map of highly cited references from publications citing Nick von Tunzelmann (Colour coding denotes co-citation of the cited references.).

5. Map of the special issue

We have argued that the traditional methodological debate on the use of history between trained historians and trained economists – as very lucidly illustrated by Lamoreaux et al. (1999) – is partly reproduced in the field of ETIS, between innovation scholars and historians of technology, with Nick von Tunzelmann's case being something of an exception in spite of his 'two lives', as shown in the previous section. Despite divisions, there is potential for cross-fertilisation between these two communities, both in the different uses of history as a research method and in the type of relevant questions to be addressed. The challenge, as will be argued below, is in what Schumpeter had named a 'chemical mix' in the use of history and theory in Marx, between a persuasive narrative account of a specific case, to add to theory, and the use of quantitative evidence – possibly stretching the latter to include cliometrics as applied to ETIS relevant questions – able to test hypotheses and to draw generalised results.

Nick von Tunzelmann can be considered as an initiator of this cross-fertilisation, as emerges from McCloskey's opening note and the article by Bruland and Smith, which proposes a retrospective assessment of Nick's seminal work on steam power.

The sequence chosen for the papers contributing to this special issue reflects the extent to which they follow in the von Tunzelmann tradition of a quantitatively "aware" approach to the use of history in ETIS and a convincing causal historical narrative. It also reflects – as in the case of Turnheim and Geels – the continuity in the technological trajectories analysed in other papers. We summarize their contributions below and then attempt an assessment of the challenges ahead.

5.1. A summary of the individual contributions to the special issue

In her witty and entertaining opening paper, Deirdre McCloskey offers an in-depth perspective on the questions we put forward, by showing that "the students of the first generation of Samuelson" underwent in the 1960s and 1970s a "turn to specialised illiteracy (. . .) fortified by a scornful ignorance of history, philosophy, theology and literature", regressing rather than progressing with respect to the "sainted Adam Smith (1723–1790); the blessed Frank Knight (1885–1946); the insightful Joseph Schumpeter (1883–1950) and the paradoxical Maynard Keynes (1883–1946)", among whom she judges Nick von Tunzelmann and herself to be among the few successors.

Despite differences in the methods of investigation, an ability to raise relevant questions and to explain long-run historical phenomena is clearly evident in these economists' respective ways of making sense of the unprecedented growth rate that has characterised the world's economy after 1800, following millennia of relative stagnation. It is the task of economic historians to explain the *changes* that occurred, which is more relevant than figuring out the conditions under which economies *converge*. The key difference, argues McCloskey, is that historians of technical change know that they cannot get away with the simple notion of factors' accumulation. The sheer routinised augmentation of capital and labour would not explain the jumps in growth rates, nor the reasons why such jumps occur only at a certain point in time and in certain places[8]. McCloskey provides a range of lively historical examples that prove the futility of capital accumulation as the only explanation for the occurrence of the First Industrial Revolution. What made the difference was the role of ideas, she argues, which resonates with Nick's notion of "practical tinkering" aimed at resolving day-to-day problems, rather than the formal accumulation of scientific knowledge (see also Mokyr, 2007).

However, interestingly, McCloskey implicitly makes the point that the methodological choices (of ETIS scholars or historians) make the use of history more or less fruitful when one has to 'explain the world' (see also McCloskey, 2010). *Modelling* rather than *explaining* growth requires an over-simplification of the mechanisms behind it, thus leading most professional economists to prefer to focus on the accumulation of measurable factors such as capital and labour rather than making sense of a process of

[8] "Finance and saving and investments cannot have been crucial, or else Florence or Augsburg (or Athens or Beijing or Istanbul) would have innovated us into the modern world" (McCloskey, 2013).

"original accumulation of inventive people" (McCloskey, 2013), which fits uncomfortably in any economic model.

The counter-argument to this view is how one responds to the challenge of addressing such questions as the following: to what extent can even a large set of narrated historical examples be generalised to be convincing as a general theory? How does one produce a convincing causal narrative on the basis of historical sensitivity only? McCloskey (wonderfully) avoids raising and addressing this crucial implication of her argument, which remains an overarching question throughout.

Bruland and Smith offer a reassessment of Nick von Tunzelmann's seminal contribution thirty-five years on (von Tunzelmann, 1978) on the role of steam power technology in spurring the industrial revolution. Interestingly for the purposes of the questions raised here, Bruland and Smith's account locates the contribution of Nick von Tunzelmann exactly at the crossroads between the themes evoked by British economic historians such as Toynbee – responsible for the systematic use of the term "Industrial revolution" – and the embryonic ETIS field at the time, which sparked into life with an interpretation of structural crises of capitalism as the main seeds for radical technological breakthrough. This latter view is what the authors label "a critical technological bias" at the core of British economic history, which started with Toynbee and his legacy.

However, technical change has been "conceptualised" or "theorized" (i.e. explicitly treated as an *explanandum* rather than the exogenous initiator of historical economic facts) for the first time by the ETIS pioneers, including Nick von Tunzelmann. This contributed to the articulation of a broader perspective on the role of technological breakthroughs for industrialisation and growth.

Bruland and Smith convincingly identify von Tunzelmann's original stand as an historian and as an 'economist of innovation' *ante litteram* (see Section 4 above), for he considers the role of the steam engine within a broader economic, engineering and social context and explains technical change-led economic growth.

Bruland and Smith rightly see von Tunzelmann's original contribution especially in his focus on Fogel's notion of *social savings* (Fogel, 1979)[9] and Hirschman's *backward and forward linkage* "effects" (Hirschman, 1958) in the case of the steam engine. But most of all, they assess von Tunzelmann's contribution in his attempt to provide a mixed methods account of technical change and economic growth. This includes a thoroughly empirical examination (a "new economic history"-style counterfactual account, say Bruland and Smith, 2013) of the (limited) economic impact of social savings and vertical linkages associated with the occurrence of Watt's engines. But they also identify an incisive and convincing use of causal narrative to make sense of historical data.

Von Tunzelmann's intellectual heritage resides, according to Bruland and Smith, both in the (empirical) reassessment of the *steam-coal nexus* and in the new "global history" question of why Europe was able to ignite innovation-based growth, a question also raised by McCloskey (2013). In particular, however, von Tunzelmann's work has allowed a "displacement of the energy-crisis interpretation and the critical technology approach". This puts in perspective the role of radical technological breakthroughs in relation to economic, institutional and social knowledge shifts that made technical change spread across sectors, shaping the structural changes of economies. Importantly, von Tunzelmann showed that these effects were real, but far from instantaneous.

A recent interpretation of von Tunzelmann's intellectual heritage on the *steam-coal nexus* is Mendonça's rich and original contribution on the reassessment of the "Sailing Ship Effect". The "Sailing Ship Effect" is well known in the innovation literature as an upsurge of technological innovation that occurs within an old technology-based sector as a result of the threat and competitive pressure coming from a radically new technology, assuming to be serving the same purposes in a more efficient manner.

Mendonça provides a convincing and fascinating reassessment of the *true* "sailing-ship effect", by examining maritime historiography and quantitative historical data and by establishing the co-existence rather than the competition between steam and sail technologies serving the commercial water transport sector. The major innovation cycle in the sail technology, Mendonça shows, occurred well before the threatening entrance of steam power, and cannot therefore be considered as a resilient upsurge of sailing-ship technology in reaction to the advent of its alleged radical technological replacement, the steam-powered ship. Mendonça convincingly challenges not only the historical evidence supposedly behind the widely accepted concept of "Sailing Ship Effect", but also the theoretical and policy implications that a large number of innovation scholars have drawn from it.

Happily for the purposes of this special issue and introduction, Mendonça asks "how recurrent" is the Sailing Ship Effect in the history of technology, and therefore to what extent can we safely generalise a theory that hinges on a single case? The case at hand is particularly intriguing as it represents an historical phenomenon that ETIS scholars have borrowed to produce a "general" theory of technological paradigm shift and structural change. Mendonça responds to this by carefully and sensibly selecting empirical evidence not only on technological, size and performance trend-breaks but also *on the possible collateral phenomena* that might have affected the occurrence of the Sailing Ship Effect, including institutional and infrastructural historical events such as the new Tonnage Law in 1836 and the opening of the Suez Canal in 1869.

Interestingly, Mendonça empirically rejects the existence of a Sailing Ship Effect in the eponymous case. This is extensively and convincingly corroborated by a wealth of economic and institutional qualitative evidence, which, amongst other things, emphasizes the role of backward and forward linkages around sail shipping (i.e. ship construction, iron use in response to timber scarcity to construct wind-powered vessels, changes in market size due to various changes in sailing routes, colonial developments, etc.). In this respect, Mendonça's work represents a substantial contribution in honour of von Tunzelmann's intellectual and methodological heritage, along the lines that Bruland and Smith emphasize in their paper.

A further example of change of historical techno-economic paradigm, this time related to the earlier historical energy transition from charcoal to coal, is offered by Steinmueller, who critically re-examines the British 'timber famine' case of the 17th century and offers revealing insights, relevant to recent concerns about long-term natural resource sustainability and the global transition towards a low-carbon economy. Steinmueller examines two possible causes of transition, one related to resource depletion and the crisis-led ('timber famine') technological shift, the other related to the pressure to seize economic opportunities from new technologies, linked to general expectations of decreasing returns from the 'old' technology.

Interestingly, he then takes a very original stand on the use of historical counterfactual, arguing that historical lessons on the transition from charcoal to coal might help shed light on the recent debate about the transition to a low-carbon economy.

[9] The assessment of *social saving*, pioneered by Fogel (1979) in his *Railroads and American Economic Growth*, consists of an attempt to empirically isolate the economic impact of the introduction of a particular technology. For instance, the *social saving* of railroads are obtained by calculating the difference between the "actual costs of shipping goods in that year and the alternative cost of shipping exactly the same bundle of goods between exactly the same points without railroads" (Fogel, 1979; von Tunzelmann, 1978; see Bruland and Smith (2013)).

The originality resides in his examination of the "path not taken" (Steinmueller, 2013) – the one based on the use of renewable timber charcoal rather than exhaustible coal, which might have changed the very modern concept of a natural resource-sustainable world. The crisis-led paradigm to explain this case of an historical energy transition is rejected, in favour of one based on the centrality of individual and collective (economic) choices. This thought-provoking analysis of the "path not taken" also allows for speculations around the possible consequences of the chosen path, in terms of intensity, timing and spatial distribution – this latter aspect often being overlooked within the ETIS field – and the occurrence of the Industrial Revolution.

Steinmueller raises an ETIS-relevant question – the determinants and economic impact of shifts from an old to a new techno-economic paradigm – and uses an economic model tested on the basis of longitudinal historical data. The findings are further corroborated – in a traditional ETIS vein – by a sensible reflection on the role of institutional change. The Timber Acts among others were enacted in the spirit of the dominant economic policy choices at the time – namely, Mercantilism.

Turnheim and Geels' contribution continues the energy theme initiated by Steinmueller by looking at the case of the British coal industry – albeit on the basis of a substantially different methodology. The case serves the purpose of showing the socio-economic context that activates the destabilisation of an existing regime in favour of a new one. In this respect, their contribution links in well with Mendonça's reassessment of the sailing ship effect and Steinmueller's reassessment of the timber famine effect, in that it offers insights on another fundamental historical case of paradigm shift. Turnheim and Geels speculate on the political pressures and industrial and organizational responses to the signs of crisis, preferring historical narrative to the use of long time-series of economic macro-data. Their consideration of different 'spheres' – political, cultural, civil society and economic – affecting the destabilisation, or 'out-of-synch phenomena', is in line with the plea for a 'Theory of Reasoned History' put forward by Freeman and Louçã (2001), paraphrasing Schumpeter.

Turnheim and Geels' qualitative account of the destabilisation of the British coal industry is creative in identifying the socio-political macro and micro-symptoms of regime shift and has the appeal of offering an all-encompassing framework[10]. This includes the role of what the authors define as *external pressures* (among which are the decline in demand and other crucial economic variables along with various socio-political events); the *industry strategic response* to these pressures (among which are the weakening of profit opportunities and incentives to invest) and the *weakening of commitment to the established regimes* (including institutional changes at various points in time and individual firms' choices in the light of growing distrust in the political support for a large and influential industry).

In contrast to the analysis of a "regime destabilization", the contribution by Pulkki-Brännström and Stoneman focuses instead on the historical global emergence and diffusion of new technologies, a traditional ETIS question[11], which naturally requires historical data and can therefore be ascribed to the cliometrics tradition.

The authors focus on three specific technological shifts, one related to the diffusion of mail services (1830–1900), the second being steam powered shipping (1809–1938) which offers a rather different (and more global) perspective from the one provided by Mendonça in this special issue, while the third is the more recent diffusion of basic oxygen process (1952–1992). The cliometric analysis tests propositions that are suggested by the theory of international spillovers and provides original insights into the historical processes of global diffusion.

Pulkki-Brännström and Stoneman (2013) consider *global* rather than just *national* diffusion, and analyse the interplay between *extensive* (reflecting use of the new technologies in previously non-using countries) and *intensive* (reflecting the spread of use at the national level after first use) diffusion of technologies. The authors assess the relative contribution of extensive and intensive 'margins of diffusion change'; the extensive being more relevant in the early years and the intensive in the latter stages of diffusion.

It is worth briefly comparing here their findings on the diffusion of steam shipping with those arrived at by Mendonça in this special issue. Pulkki-Brännström and Stoneman apply a traditional epidemic model of diffusion to explain the paradigm shift from sail to steam shipping and find a traditional S-shaped curve over the time span analysed (1809–1938) across countries. Interestingly, the authors find that the epidemic model of diffusion turns out not to be fully appropriate for explaining the diffusion of steam ships in almost half of the countries examined (Finland, US, Austria, Italy). When looking at the UK and US, the two major users and producers of steamships, Pulkki-Brännström and Stoneman find that steamship diffusion had little to do with the role of international spillovers. Admittedly the authors point out that the historical phenomenon at hand requires an interpretation that is able to allow for multiple causality and over-determination (Geels and Schot, 2010).

Pulkki-Brännström and Stoneman see their contribution as being in line with the tradition of theoretical and methodological synergy initiated by von Tunzelmann[12]. Yet the piece would have maintained the tradition still more through efforts to provide a 'causal narrative' that does justice to the historical institutional and macro-level changes in explaining the plausibility (or the implausibility) of the estimated coefficients of technological diffusion.

A relevant ETIS question, very much related to the patterns of diffusion of technologies and overall incentives to produce breakthrough innovations, relates to the propensity to patent inventions. Fontana et al. (2013) reappraise this topic in their paper, focusing on the *decision* to patent and, more generally, on the appropriability strategies of firms that choose from a portfolio of protection methods, among which patents are the most widely used. The authors tackle the issue of the comparative patent propensity through an econometric analysis of an interesting database, generated by linking USTPO with the "R&D 100 awards" journal archive, and covering a recent period of considerable "historical relevance" (1977–2004).

Fontana et al. argue that historians of technical change have usually looked at the *patenting rate* (the ratio of patented inventions out of the total number of inventions) rather than the *propensity to patent* (the ratio of patents to the total R&D expenditure), as their preliminary survey of both ETIS and the history of technical change literature shows.

Having compared their results with the existing literature, Fontana et al. argue for more awareness of archives and data sources of specific technical fields, complementary to the ones traditionally used within the ETIS field. This would benefit – from both a theoretical and a methodological perspective – from embodying a typical historical framework of inquiry, which makes use of a more straightforward indicator of patent propensity. This is especially so, given our 'lateral search' for *bridging concepts* and *tools* between ETIS and historians of technical change.

[10] This is consistent with the methodological stand that Geels and Schot (2010) take to support the "process" rather than "variance" approaches. In this respect, the multilevel perspective shares the inter-disciplinary yearning of many scholars belonging to the ETIS field. We return to this discussion in the following section.

[11] Suffice here to note that the influential works of Mansfield (1968) and Rosenberg would fit comfortably with contemporary cliometric work within the economic history community (see Section 3 for an overview).

[12] This is evident in Nuvolari et al. (2011), who reappraise Nick von Tunzelmann's early work on steam power in Britain on the basis of 'traditional' cliometric analysis.

Bakker (2013) looks at the historical evolution of cash flow funding of large R&D projects since 1750, showing how the case firms examined in the study were able to manage financial constraints. Bakker raises R&D-related financial issues that are well known within the ETIS field: sunk costs, uncertainty, long time-lags between investments and returns from innovation, adverse selection and moral hazard. He reappraises these in the light of certain project-based characteristics, drawing from historical cases and identifying implications for some of the major R&D financing of modern times. R&D financing – Bakker argues – is more sensitive to cash flows rather than capital; however, ever since the mid-18th century, firms have been able to overcome uncertainty by making sure that large cash outlays were available before venturing into a large R&D project.

Last but not least, Perren and Sapsed's contribution provides a thought-provoking analysis of the evolution of the use of the term *innovation* in UK policy discourse over the past forty-five years of UK Parliamentary debates, showing the extent to which language is an overarching, crucial element in the diffusion of ideas and ideologies within innovation policy. The authors draw upon a historical database so far overlooked by the ETIS field, the UK parliamentary records, to construct a unique linguistic dataset of collocated words. The authors base their analysis of the evolution of the word *innovation* "through the lens of theories of politically charged meaning and discursive action in relation to policy making" (Perren and Sapsed, 2013).

They derive a number of interesting implications for both ETIS-relevant questions and for innovation policy at large. The use of the word *innovation* has increased over time and has been increasingly associated with positive language, with the focus being disproportionately on drivers rather than barriers. This diffusion mirrors that of the term in academic scholarship. The prevalent discourse on innovation policy is shown to have adopted some of the 'systems of innovation' thinking, even if the term's performative power may explain much of its usage.

For the purpose of this introduction, it is worth noting that the authors suggest another methodological category with regard to the use of history compared to those suggested in our initial challenge. Discourse analysis would seem to add to the range of methodological tools available for the use of history in ETIS at large. Furthermore, Perren and Sapsed's study may pave the way to a systematic cross-country comparison of different legislative and political discourses, which could illuminate cross-country differences in power structures and political debates in a fruitful manner.

5.2. Conceptual and methodological achievements and challenges ahead

Section 3 has attempted a first rough typology of the potential uses of history within ETIS. We have deliberately avoided reproducing the rather sterile dichotomy between 'mainstream' and 'non-mainstream' approaches in both economics and economic history. Instead, we have focused on heuristics used in history. The collection of papers included here has illustrated the intrinsic methodological inter-disciplinarity use of history in ETIS. Here we reconsider those categories in the light of the specific uses of history that our contributors have adopted or proposed. To do so, we consider a continuum of degrees of employment of economic rather than inter-disciplinary categories; statistical and econometric analysis of long-term historical data *also* rather than narrative accounts *only*; and a conservative rather than a looser notion of institutional/regulatory change involving different actors. We reflect on possible ways of ensuring mutual enrichments between those operating at the extreme points of such a continuum, as a way to honour Nick von Tunzelmann's intellectual heritage and identify a series of challenges ahead.

In line with Geels and Schot (2007, 2010), Turnheim and Geels (2013) identify three ways in which history might benefit the ETIS field from an epistemological and methodological point of view, which we discuss here, namely:

(1) Temporal unfolding "awareness"
(2) Causality and co-evolution
(3) Narrative explanations

However, our views on these three aspects are slightly different from those of Turnheim and Geels. Paying particular attention to the temporal unfolding of events and processes can hardly be claimed to be a history-specific characteristic (see Section 3 above). Yet, it is true that one of the core bridging concepts between the ETIS community and economic historians and historians of technical change is *path-dependency*[13], which is able to contend with different "time-speeds" with regard to the unfolding of events, whether sudden radical changes, medium-run political strategies, or slow long-run historical events.

ETIS scholars, like historians, as discussed in Section 2, tend to recognise the existence of multiple causality and to acknowledge that phenomena might be over-determined. The rejection of neo-classical assumptions of perfect rationality and agents' homogeneity is methodologically inconsistent with the accusation of providing "mono-causal explanations". Such a dichotomy resonates in discussions of the counter-position of variance versus process approaches suggested by Van de Ven (2007) and referred to by Geels and Schot (2007).

Rather, we optimistically believe that *in medio stat virtus* [14] and that a bold belief in over-determination, multiple dimensions of causality and "lateral thinking" risks a resulting indeterminacy. Indeed, some of the contributions to this special issue, such as those by Mendonça and Steinmueller, have been able to provide a wealth of convincing causal links coming from "historical narrative reflection" which have usefully complemented the use of econometrics and economic modelling respectively. We should therefore be cautious in methodological counter-positioning here, to avoid the risk of reducing a potentially fruitful methodological cross-fertilization.

This leads us to turn our attention to the use of narrative explanations, towards which most historians show a certain proclivity. The method of *causal narrative* is, in our view, an important one. It embeds all the dimensions discussed above, in particular the awareness of temporal unfolding and a convincing justification of multiple causality and lends itself as a *bridging tool* between ETIS scholars and historians. Empirical causal testing may be encompassed in the way history is used, both within the ETIS field and among historians of technical change, as Nick von Tunzelmann has done throughout his whole career, paying particular attention to the use of causal narrative.

In line with von Tunzelmann's cautiously open-minded stance on the potential of the role of cliometrics – once freed from its orthodox foundations – we believe that one of the most promising areas for cross-fertilization between ETIS and history of technology lies in the use of a new 'chemical mix' of cliometrics – ideally testing *reduced forms of heterodox economic models*[15] – and causal narrative. This would be consistent with the Schumpeterian plea for the

[13] We thank Johan Schot for fruitful discussions on the topic.

[14] A Latin saying for "Virtue stands in the middle" (Horace), i.e. virtue lies in the moderate, not the extreme position. Here our 'medio' is intended more as a combination and mutual enrichment rather than its Latin meaning of the 'middle'.

[15] It is outside the scope of this introduction to go into more detail in this issue. Instead, it is enough here to quote what Leontief (1948, 1963: 1–2) – who can hardly be considered as an heterodox, a-mathematical, a-quantitative scholar – argued for with respect to the use of historical inquiry in search of the developmental process based on models of 'less aggregate form'.

indispensable pillars of any training for social scientists aimed at explaining economic change – namely, *history, statistics and theory* – and with the ultimate aim of contributing to a "Theory of Reasoned History" (Freeman and Louçã, 2001). The reason for this agenda is not only a theoretical and methodological one. Rather, we believe that the sensible use of empirical and econometric testing of non-orthodox models' reduced forms may be valuable in deriving conclusions useful for policy. Let us therefore conclude this section by quoting a wise reflection on the use of history by one of the contributors to this special issue:

> "The transformation of a historically-rooted observation into a concept remains a delicate manoeuvre and surely abstractions must be judged first and foremost by their fit to the case from which they are extrapolated. History constitutes a uniquely productive area for "basic research" in the social and economic sciences, i.e. a source of new conjectures as well as of empirical data for hypothesis testing. Nevertheless, the role of historical analysis as a tool for theoretical variation and selection in fields such as innovation studies is best approached in the same careful and sceptical way as any other methodology. It may well be that one risks learning imprecise history lessons and that this may bias the search for new facts and the retention of policy ideas. Fortunately the past is rich enough to enable a continuous work of improvement over what constitutes useful knowledge for the future." (Mendonça, 2013)

6. Concluding remarks

This article introduces the special issue on 'Economics, innovation and history: Perspectives in honour of Nick von Tunzelmann'. We have raised the issue of the potential cross-fertilization between two communities, that of historians of technical change and the large field of studies on the economics of technical change and innovation, in terms of both relevant questions and methods in the use of history. We have asked what history is and how it has been approached. We have briefly reviewed the evolution of the troubled relationship between economic historians and economists, and considered how this is reflected in the evolution of the debates common to the ETIS field and the history of technical change. We have traced the intellectual roots of these two complementary fields, noting how Nick von Tunzelmann has led a 'double (academic) life' as both economic historian and innovation scholar, successfully bridging the two communities, most especially by using history both in the vein of cliometrician and by providing refined and convincing causal narratives on a wealth of historically relevant questions for the ETIS field, as the articles by McCloskey and by Bruland and Smith show.

We have argued for ways in which different methods in the use of history might mutually benefit both fields. The range of contributions to this special issue incorporate a wide spectrum of these methods, ranging from modelling to the use of historical data, from the use of archives to reconstruct historical phases and reinterpret contemporary economic phenomena, to the contribution to ETIS theoretical frameworks through the use of history. In some cases, a rich 'chemical mix' of historical empirical analysis and use of causal narrative has revealed new insights from the reinterpretation of historical facts that add to theory and provide convincing explanations of modern historical turns.

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