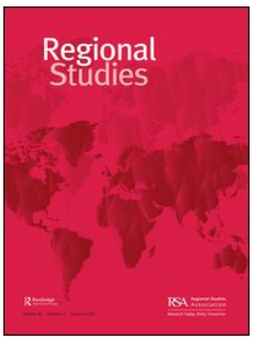

Regional Studies

ISSN: 0034-3404 (Print) 1360-0591 (Online) Journal homepage: https://www.tandfonline.com/loi/cres20

# Time should tell (more): evolutionary economic geography and the challenge of history

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**To cite this article:** Martin Henning (2019) Time should tell (more): evolutionary economic geography and the challenge of history, Regional Studies, 53:4, 602-613, DOI: 10.1080/00343404.2018.1515481

**To link to this article:** https://doi.org/10.1080/00343404.2018.1515481



Published online: 20 Sep 2018.

REGIONAL STUDIES
2019, VOL. 53, NO. 4, 602–613
https://doi.org/10.1080/00343404.2018.1515481

Routledge
Taylor & Francis Group

Regional Studies Association

URBAN AND REGIONAL HORIZONS



# Time should tell (more): evolutionary economic geography and the challenge of history

Martin Henning

**ABSTRACT**

Evolutionary economic geography theory stresses the importance of time and history to explain the evolution of regional economies. Yet, consistent empirical treatment of longitudinal patterns of regional evolution has largely escaped the focus of this new approach. There is much work in progress, which suggests that a deepening of the historical perspective is the next natural step in a further development of evolutionary economic geography. However, there are also theoretical, empirical and methodological challenges to 'taking evolutionary economic geography historical'. In this endeavour, much could be gained from insights from time–geography, economic history and the literature on longitudinal methodologies.

**KEYWORDS**

evolutionary economic geography; time and geography

**JEL** B15, N01, O18, R1

**HISTORY** Received 2 March 2018; in revised form 10 August 2018

## TIME, SPACE AND ECONOMIC EVOLUTION

In describing the rationales of his new approach, Torsten Hägerstrand, the famous inventor of time–geography, lamented that: 'The division between a distinct time perspective and a distinct spatial perspective is something given by tradition, and something which I perceive as a weakness' (Hägerstrand, 1991, p. 134; present author's translation). The evolutionary economic geography (EEG) approach, developed in the wake of the seminal writings of Storper (1997) and Boschma and Frenken (2006), has in many ways worked to remedy the weakness perceived by Hägerstrand. Like few other approaches, EEG recognizes the importance of both time and history to a scientific understanding of regional development. In this sense, EEG offers a framework that not only enables one to say that time and history matter for regional economic development, but also *how* they matter. When Boschma and Frenken (2006) were positioning the emerging EEG approach with reference to institutional economic geography and neoclassical economic geography, the conceptualization of time was one of the main variables of disagreement between the approaches. Moreover, the first empirical works paving the way for an EEG were using historical material (Boschma, 1997; Boschma & Van der knaap, 1999; Storper & Walker, 1989). Essentially, economic change through time and history is deeply engraved in basic assumptions and arguments regarding what an EEG should be concerned with.

Despite this, the consistent empirical treatment of longitudinal patterns of regional economic evolution has, with a few exceptions, escaped the focus of EEG. The empirical shortcomings of this are obvious. The evolutionary mechanisms of variation, selection and retention active in regional economies are likely to have worked differently during times when regions were less integrated, people were less mobile, communications were more cumbersome, and core technologies and professional hierarchies were different from today. The underrepresentation of historical studies in EEG partly calls into question the historical validity of its core mechanisms as regards explaining regional economic development (e.g., Boschma & Fornahl, 2011; Crespo, Suire, & Vicente, 2014). Instead, a growing branch of historical economic geography is dominated by scholars working in the tradition of New Economic Geography (for a summary, see Krugman, 2000; see also Crafts & Mulatu, 2005; Martinez-Galarraga, 2012; Rosés, 2003; Wolf & Rosés, 2018).[1]

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In a time of rapid advancement of EEG and a continued debate about what an EEG 'should be' (Boschma, 2017; Hassink, Klaerding, & Marques, 2014; Kogler, 2015; Martin & Sunley, 2015; Pike, MacKinnon, Cumbers, Dawley, & McMaster, 2016), the prerequisites for conducting historical studies in EEG are changing quickly. Concepts are being fine-tuned, new data sources are being developed and EEG scholars are slowly becoming more comfortable using longitudinal data and longitudinal research methods. However, this trend faces theoretical, empirical and methodological challenges.

First, while EEG has productively drawn on evolutionary economics, innovation economics and classical economic geography, in formulating its basic propositions, insights from adjacent traditions in human geography concerning the relationship between *time and space* have so far been largely neglected. Key insights from this literature can help EEG to bridge one of the most important theoretical hurdles remaining in the development of a more historical stance.

This is necessary in order to accommodate a second challenge facing contemporary EEG, that is, using a greater degree of what could be called, in analogy with Boschma (2017), 'temporal wisdom' in the interpretation of results. Established (but often non-spatial) findings concerning real economic history, such as the development of technologies, transport systems or indeed institutions over time, can fruitfully inform evolutionary interpretations of regional development patterns.

Lastly, longitudinal research efforts are certainly not without their empirical hurdles and methodological pitfalls. Just as spatial data require specific considerations, so do historical data. From both the historical sciences and the general methodology literature, insights can be drawn in order to stimulate longitudinal research of even higher quality in EEG.

This paper takes stock of the longitudinal contributions in EEG and their use of time and history to discuss some prominent gaps and biases, and to suggest what could be learnt from other adjacent approaches. In particular, it looks to time–geography, economic history and the research methods literature. It thus asks:

- What is the current status of longitudinal research in EEG?
- What will evolutionary economic geographers be able to learn from time-geographers and economic historians?
- What will the next steps be in making EEG more of a historical and time-conscious body of research?

The paper begins with a few definitional notes. By reviewing the current state of empirics in EEG, it then shows how EEG has thus far largely come to focus empirically on rather recent geographies and mechanisms of change. While these studies have provided essential findings, longitudinal studies have much to offer the evolutionary approach. Three subfields are pointed out, wherein we believe historical studies to be especially promising. The paper then discusses how time–geography, economic history and insights from the research methods literature can contribute. Lastly, the paper ends in cautious excitement as the evolutionary approach to geography takes its next step by *letting time tell more*.

## SOME CONCEPTUAL CLARIFICATIONS ABOUT TIME AND HISTORY, AND A SHORT DISCIPLINARY RETROSPECTIVE

### Time and history

This paper makes a distinction between time and history (Table 1). Time is used in a commonsense way, meaning: 'A nonspatial continuum in which events occur in apparently irreversible succession from the past through the present to the future' or 'An interval separating two points on this continuum' (*The American Heritage Dictionary of the English Language*, n.d., *s.v.* 'time'). Time can be perceived in the form of either abstract time, one-dimensional time with little notion of whether time is long or short in an absolute sense (for laboratory time, see Corpataux & Crevoisier, 2007), or real time (seconds, hours and so on).

History, on the other hand, is defined by: 'A chronological record of events' and 'The branch of knowledge that records and analyzes past events' (*The American Heritage Dictionary of the English Language*, n.d., *s.v.* 'history'). This paper will mainly discuss history in terms of events taking place before the current technology shift *c.*1980 (Schön, 2010). Here, too, abstract history and real history can be distinguished. Abstract history, for example, applies to the theoretical distinctions of major historical periods that can be found in economic history and historical economics, for example, the succession models (Martin & Sunley, 2007) of the technology shifts (Schön, 2010) and long waves (Van Duijn, 1983). Real time can be seen as the real and contextual historical periods during which the economy evolves (Martin, 1999). Accounts analyzing these periods incorporate features such as the diffusion of particular innovations, and observations of institutional change (Freeman & Louçã, 2001/2010). The category of real history could also be regarded, by paraphrasing

**Table 1.** Time and space concepts in a two-by-two matrix, where a specific regional approach may emphasize time and/or history, as well as abstract or real, including examples of features.

| | Abstract | Real |
|---|---|---|
| Time | 'Laboratory time' (Corpataux & Crevoisier, 2007) | Hours<br>Days<br>Weeks<br>Periods, e.g., 1900–80 |
| History | Industry life cycles<br>Succession models: technology shifts, long waves<br>Complexity models (Martin & Sunley, 2007) | 'Temporal wisdom'<br>Industrial revolutions<br>Empirical knowledge of diffusion of technologies<br>Empirical knowledge of institutional change |

Boschma's (2017) call for geographical wisdom in diversification studies, as a call for 'temporal wisdom'.

### A short disciplinary retrospective on time and space

Recognition of the value of a historical perspective in explaining regional economic development is not new to economic geography. There seems to be widespread consensus among representatives of many academic disciplines that time somehow matters to economic processes. Scholars of very different strands can unite under reasonable phrases such as: 'Geography and history, in other words, are key to understanding the economic process' (Garretsen & Martin, 2010, p. 130).

However, the dimensions of time and space have been treated in remarkably different ways throughout the history of the discipline (Corpataux & Crevoisier, 2007). In commenting on Max Weber's classic work *Über den Standort der Industrien* (1909), Walter Isard, in *Location and Space-Economy* (1956), even highlighted the fact that, in his view, 'Weber pursued an essentially evolutionary approach' (p. 28). Scholars working in the traditions of the earliest location models, or locational models based on Newtonian ideas and equilibrium ideals, did not ignore issues of time, especially in the abstract sense (Corpataux & Crevoisier, 2007; Garretsen & Martin, 2010; Hoover, 1948). However, there were limits to their approaches: 'a chief limitation of this volume is its inability to cope satisfactorily with the development process over time' (Isard, 1956, p. viii). The main ambition of identifying general laws about location allowed these approaches to circumvent the issue of how regions develop into historically contingent outcomes through a meaningful longitudinal process (e.g., Isard, 1956; Yeates, 1968; see also Sheppard, 2000).

With Paul Krugman's introduction of *New Economic Geography* (Krugman, 1991, 2000), the economics-minded locational theory tradition took another, and much more explicitly time-oriented, twist. While New Economic Geography has been proven to be a relevant tool for some longitudinal applications in economic history (Martinez-Galarraga, 2012), the framework still leaves many historical aspects unaccounted for. Much the same goes for the tradition of (stylized) urban economics, where models have attempted, for example, to capture regional learning effects connected to the life cycles of firms (Duranton & Puga, 2000).

The focus on the endogenous capacities of regions to generate transformation and growth, resulting in the interest in industrial districts, learning regions and regional clusters (Moulaert & Sekia, 2003), has mainly rested on a set of theoretical explanations, some of which were often associated with long-term regional resource development. Examples might include the formation of hard-to-imitate human capital connected to the discussion about Porter's clusters (Porter, 1990, ch. 4) or important historical institutions. In general, these approaches championed the idea that 'the economy has to be understood in a real life situation, that is to say that players are in a specific situation, inherited from the past, where certain perspectives are open to them while others are closed' (Corpataux & Crevoisier, 2007, p. 298). This points succinctly towards invoking a real history perspective. Scholars working in this tradition frequently engage in developing a deep understanding of regions, involving the relating of regional particularities of development to developments in real history over real time (e.g., Amin, 2003).

Compared with previous approaches, EEG has made interest in both abstract and real time one of its explicit major trademarks (Kogler, 2015). Time can be seen as inherent to the entire notion of economic evolution. According to Boschma and Martin (2010), the goal of EEG is to engage with the ideas of evolutionary economics: 'to help and explain how the economic landscape changes over historical time … but also how space impacts the change of the economic system itself' (p. 6). Regional economic development is seen as an outcome of a process (Storper, 1997), whereby the evolutionary core principles of variety introduction, selection and retention (Essletzbichler & Rigby, 2010) all have an extension through time.

This partly explains why friction in time (Lee & Saxenian, 2007; Storper, 1997) is so important in EEG. It takes time for ideas and innovations to grow, develop and diffuse; it takes time for the market to select and for policy to influence that selection (if it does), and it takes time for the dynamics of retention and regional path dependency to impact regional development (Henning, Stam, & Wenting, 2013; Martin & Sunley, 2006). However, in EEG, regarding time as a friction and history as a context also implies that factors may intervene and influence the speed and direction of change processes. As EEG analyzes spatial outcomes in the light of both abstract and real history, as well as real time, the ontology and epistemology invoked by EEG allows practitioners to iterate between primarily abstract history, real history and real time.

## TIME AND HISTORY IN EEG

### The current empirical situation

Investigating the current state of longitudinal empirical EEG[2] first requires one to define the boundaries of the approach itself. In this text, a point of departure has been taken in some important works and reviews published in the field during recent years (e.g., Boschma & Frenken, 2006, 2011; Frenken, 2007; Lambooy, 2010; Boschma & Fornahl, 2011; Martin, 2012; Martin & Sunley, 2011; Kogler, 2015; Boschma, 2017). From there, references have led the way to other scholarly work. One important selection mechanism used has been that works refer explicitly to the core ideas of EEG, or to a debate within the emerging EEG tradition. Complementary to this, recent work done in core outlets, for example, the Papers in Evolutionary Economic Geography (PEEG) working paper series (see below), has been considered. Searching for additional contributions ceased when the list of highly relevant and direct references ran out. This search principle also means that the list of works is selective and might disregard some interesting contributions. In terms of identifying the main tendencies and approaches used within EEG,

the work covered is believed, however, to be sufficient for the purposes of this text.

The construction of an empirical EEG started as a historical endeavour (Boschma, 1997; Boschma & Van der knaap, 1999). However, with time, and as theories grew increasingly sophisticated and demands placed on data increased, a divide became apparent between the theoretical ambitions of EEG to integrate the dimensions of time, history and economic geography, on the one hand, and the empirical evidence, on the other. Two of the seminal collections assessed the early state of EEG. The vast majority of chapters rely on recent data and limited time-series. In *The Handbook of Evolutionary Economic Geography* (Boschma & Martin, 2010), only three of the 11 explicitly empirical chapters extend their analyses to take into account developments during the 1970s, and one chapter starts its analysis in the 1980s. In Frenken's *Applied Evolutionary Economics and Economic Geography* (2010), 11 chapters have an explicit empirical angle. Two chapters used data predating 1990, and only one chapter used a regional case covering the entire post-war era. Moreover, the three special issues, or special sections devoted explicitly to EEG and published in leading journals – i.e., *Journal of Economic Geography* (2005), vol. 5; *Economic Geography* (2009), vol. 2; and *Regional Studies* (2015), vol. 5 – contain no empirical articles reaching any further back or concerned with empirics before 1977.

Clearly, much of the focus on recent regional economic evolution has to do with data availability. Did things change, with the approach growing more mature? Figure 1 shows the real-time distribution of the main empirical materials in the 82 papers in the PEEG series between 2015 and 2017.[3] Bars show the share of empirical studies using time-series starting during particular periods (with most reaching quite recent years). More than 70% of the papers use materials covering the period after 1990, or more recent periods. A few studies engage with empirical material covering parts of the 1970s, and almost none reaches any further back than that. On the other hand, only a few studies engage in cross-sectional analysis.

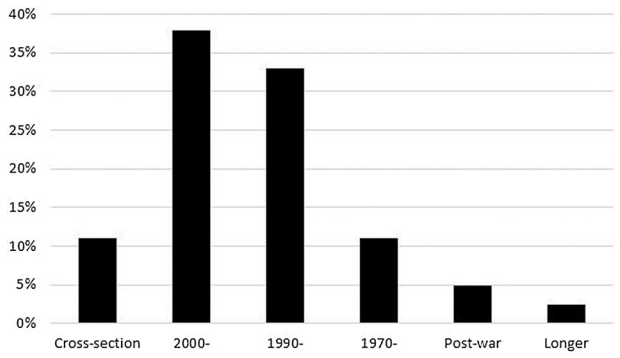


**Figure 1.** Time distribution (span) of the empirical material in the 82 empirical papers in the Papers in Evolutionary Economic Geography (PEEG) working paper series, 2015–17 ($n = 82$). Classified according to initial year of time-series or cross-section.

The majority of empirical contributions in EEG seem to take time into account (which in most cases is short), but not history. But how much time, in the real sense, is actually required in order for something to be evolutionary? There is currently no immediate answer to this, and how long the relevant time period is may differ depending on both context and which of the two broad directions of EEG are followed in a study: knowledge development and diffusion between regional actors or the evolution of regional economies (Storper, 1997). In current EEG research, periods are typically restricted to our own era of economic development, during which there has been a rapid diffusion of new technologies and institutions shaping a new techno-economic paradigm (Freeman & Louçã, 2001/2010), referred to by some as a third industrial revolution (Schön, 2010).

Of course, not all EEG studies should, or could, be historical. Shorter periods of study could quite comfortably be accommodated within the evolutionary approach. However, because the foundations of EEG rest so much on notions of evolution, change and history, *more* contributions ought to be historical. There are some clear scientific consequences of the partial disregard of abstract and real history by EEG:

- The ambitious claim of evolutionary theory matched with scarce historical evidence makes many aspects of the theories underdetermined.
- In terms of real history, EEG relies on explanations from the current technological paradigm, and often just a sequence of it.
- We have a limited empirical understanding of the 'initial contexts' or 'emergence conditions' (Crespo, 2011) that condition regional economic growth.
- By not investigating longitudinal paths for long enough, EEG runs the risk of mis-measuring mechanisms of change and conflating empirical explanations and, ultimately, meeting similar objections to those raised by Storper and Walker (1989, p. 33) when commenting on Pred's (1966) city model focusing on initial advantages and cumulative causation: 'A slightly longer-term view than Pred's leads to rather different conclusions.'

## Recent developments

Despite considerable challenges, recent developments within EEG may, with time, remedy the artificial division between geography and history, as described by Hägerstrand. In particular, three research themes within EEG are with great velocity developing a clear historical perspective: (1) research on meso-level spatial structures; (2) technologies and innovations in space; and (3) firm- and individual-level micro-level spatial structures. Real time, and abstract and real history are increasingly being taken into account to explain the evolution of regional economies.

In investigating changes to *meso-level spatial structures*, evolutionary interest has focused specifically on industry transformation and regional diversification paths. Neffke, Henning, and Boschma (2011) studied more than 30

years of regional change in Sweden, starting in 1968. Neffke, Henning, Boschma, Lundquist, and Olander (2011) used the industry life-cycle approach to study how agglomeration externalities developed over time in Swedish manufacturing industries between 1974 and 2004, while Diodato, Neffke, and O'Clery (2018) very recently used 100 years of regional US data to study how the importance of different types of industry linkages affects co-agglomeration over time. Boschma (2017) argues that one of the key challenges of future EEG research is figuring out how factors that condition diversification paths work. Historical perspectives are necessary in order to solve this, and data sets are developed, providing the means for historical expansion.

One prominent research issue that has also attracted some evolutionary interest is the link between recessions and longer term regional economic outcomes. This is closely linked to the growing body of literature on regional resilience (Boschma, 2015; Martin, 2012; Martin, Sunley, & Tyler, 2015; Pike, Dawley, & Tomaney, 2010). This literature has long-term studies of regional shocks and recovery of a more general nature (Cellini & Torrisi, 2014; Fingleton, Garretsen, & Martin, 2012), as well as studies employing a more explicit evolutionary angle (Di Caro, 2015; Doussard & Schrock, 2015; Eriksson & Hane-Weijman, 2017). Exactly how different types of resilience matter at different points in real history, what creates resilience and how resilience links to structural change via selection in regional economies largely remains to be systematized.

One question relates to the issue of regional convergence and divergence over time, a field where EEG thus far has had rather little to say. European data sets on long-term regional gross domestic products (GDPs) will soon become available as a part of the European Science Foundation (ESF)-funded project the Historical Economic Geography Project (HEGPro), which offers the possibility of positioning the development of regions in real historical time, and in relationship to other regions (Wolf & Rosés, 2018). Additionally, the Integrated Public Use Microdata Series (IPUMS)/North Atlantic Population Project (NAPP) collects historical census data for several countries as far back as the 18th century.[4] These and other historical data sets will enable the EEG to take on the challenges of the convergence/divergence debate. In particular, this concerns the issue of how rapid technological and institutional change, for example, during the technological revolutions, is followed by periods of more incremental change, and how such sequences create regimes of spatial development (Enflo & Henning, 2016; Lambooy, 2010; Lundquist, Olander, & Svensson Henning, 2008). The link between the longer term regional convergence/divergence literature and the contributions regarding regional resilience also remains promising but under-developed (Fingleton et al., 2012).

Longitudinal regional case studies can also provide insightful evidence of causal relationships in particular regions. While historical case studies of regions have proud traditions in economic geography, going all the way back to the descriptive tradition (Scott, 2000), more evolutionary regional case study work is particularly necessary from a historical perspective (Mossig & Schieber, 2016), especially concerning the role of regional institutions, knowledge network development (Boschma & ter Wal, 2007) and the initial conditions of new path formation. The work done by Hassink (2007), Trippl and Otto (2009), Sydow, Lerch, and Staber (2010) and Østergaard and Park (2015) can serve as early evolutionary examples of such ambitions.[5]

One important development in this regard has been the growth of the literature concerning the life cycles of regional clusters (Boschma & Fornahl, 2011; Crespo, 2011; Menzel & Fornahl, 2010). Theoretical contributions concerning this issue, and especially what triggers movement between the stages of cluster growth (Crespo, 2011; Menzel & Fornahl, 2010), has been accompanied by a small but growing number of studies devoted explicitly to evolutionary change in regional clusters (Hervas-Oliver & Albors-Garrigos, 2014; Martin & Trippl, 2017; Mossig & Schieber, 2016; Shin & Hassink, 2011). However, Boschma and Fornahl (2011) note the unsatisfactory empirical situation as regards the empirical validation of the cluster life-cycle approach, while Martin and Sunley (2011) question the long-term validity of the concept, arguing instead for a complex adaptive systems approach.

Promising data developments will also enable researchers in EEG to engage in long-term analysis concerning evolving *technologies in space*, especially the spatial structures of patenting and innovations. Petralia, Balland, and Rigby (2016) present, for example, an evolving database of US patents between 1836 and 1975, while Fritsch, Sorgner, Wyrwich, and Zazdravnykh (2016) identify remarkable spatial persistence in entrepreneurship rates in the Kaliningrad (Königsberg) region, comparing data from 1925 with 2010. While few geographical analyses of these long-term innovation and entrepreneurial patterns have been conducted so far, this is one of the most promising avenues for long-term EEG research.

What might be the best-researched historical field in EEG is concerned with the *firm- and individual-level spatial structures* and organizational inheritance. Initiating a new stream of studies, albeit not initially explicitly evolutionary, Klepper (2002) and Buenstorf and Klepper (2009) showed how experience of related industries can be brought into new and successful business endeavours, resulting in spatial clusters. Adding a strong EEG perspective when exploring the industry relatedness dimension of qualitative change, Boschma and Wenting's (2007) study of the British automobile industry between 1895 and 1968 and Heebels and Boschma's (2011) study of the Dutch publishing industry between 1880 and 2008 both revealed that experience in related industries significantly contributes toward the success of the firm. Morrison and Boschma (2017) draw both on Klepper's heritage theory, more traditional geographical agglomeration accounts, and on regional institutional aspects when explaining the spatial evolution of the motorcycle industry in Italy. As some individual-level large scale data sets are now

becoming available (Eriksson, Henning, & Otto, 2016), full-population transition schemes between industries and firms may in the future provide further evolutionary insights into the diffusion of routines on a wider basis.

All in all, there is plenty of time in contemporary EEG, but there is not much long real time and very little history. However, as indicated above, the trend looks promising. Making EEG even more historical requires careful consideration of the following three aspects:

- EEG has not developed a distinct firm- and individual-level micro-oriented approach that can take into account how the prerequisites of network formation change with time and history.
- EEG has only partially accommodated theories of abstract history and lessons from real history in order to analyze how economic space evolves over time.
- EEG has largely disregarded the methodological challenges facing longitudinal research.

Fortunately, EEG can approach these issues by drawing on advances made in adjacent disciplines.

## LEARNING FROM OTHER APPROACHES

### Prerequisites for network formation over time and history: time–geography

The impacts of a wide range of proximities are discussed in EEG (Boschma, 2005) and recent contributions have introduced dynamic aspects to the study of proximities (Broekel, 2015). Despite this, the different forms of proximity, especially the geographical, often adopt a rather static guise, both in evolutionary theory and empirics. Additionally, recent studies conducted in EEG regarding flows of individuals do not generally take into account how the prerequisites for flows change over time, with the development of both communication technologies and institutions (Eriksson et al., 2016; Neffke & Henning, 2013). Specifying exactly how space acts as a force of friction on processes of variation, selection and retention, and how this changes with time, is key to understanding the mechanisms of regional long-term economic evolution. For example, regional integration, by means of improving communications over the last 100 or even 20 years, has drastically changed the prerequisites for knowledge exchange and the spatial extent across which the regional resource acquisition of firms is normally possible. To overcome this drawback, EEG will have to establish a micro-approach, especially centred on the role of individuals and how they interact within and across firms and regions, to studying the relationship between time and space, how it can change, and how this impacts core evolutionary processes.

The *time–geography* approach (Hägerstrand, 1970a) shares with EEG its view of the theoretical importance of micro-level processes, organized within organizational and institutional frameworks. As Hägerstrand himself stated: 'With a concern for the individual, it follows that we need to understand better what it means for a location to have not only space coordinates but also time coordinates' (Hägerstrand, 1970b/1991, p. 145). Time–geography, excellently summarized by Pred (1977), offers a consistent framework for considering an individual's position in time and space through a choreographic path in time and space, and how specific paths are allowed and restricted by constraints that affect the individual's possibilities to join activity bundles to perform specific projects. Three major types of constraints affect an individual's possibility of participating in bundles in time and space (Pred, 1977). Depending on transport efficiency, capability constraints are imposed, but also due to other basic needs (e.g., sleep). Coupling constraints define the time and space conditions required to enable individuals to take part in a bundle (e.g., how long they need to form bundles in order to complete a specific project), while authority constraints deal with accessibility in time and space, determined by laws or power relations, for example. The key focus of time–geography is, therefore, a coordinatory issue scantly dealt with by EEG (Hägerstrand, 1986/1991; Pred, 1977): 'It means primarily that time has a critical importance when it comes to fitting people and things together for functioning in socio-economic systems' (Hägerstrand, 1970b/1991, p. 145).

Drawing on the ideas of time–geography, of particular interest to EEG would be how changes in the constraints, over time, affect the EEG core mechanisms of introduction of variation, selection and retention. For example, alterations in the capability constraints through travel times may rapidly change access to economic variety in the regional economic environments and change the characteristics of the regional market, whereas information technologies cause changed coupling constraints that may affect where and how new projects are assembled in regions. Also changes in regional institutions may affect authority constraints faced by economic actors, thus changing the prerequisites for meaningful regional economic interaction.

More concretely, time–geography provides conceptual tools for facilitating research in three areas in contemporary EEG, that is, paths as portfolios, innovation and diffusion, and economic complementarities. Analogous to time–geography, the life path of an individual can be regarded as an accumulation trajectory of skills and experiences over time and space. This idea is not new to economic geography (Törnqvist, 2004); however, recent contributions to EEG have, for example, started to investigate how the skill portfolios of individuals affect plant productivity (Östbring, Eriksson, & Lindgren, 2016).

The idea that time–geography can fruitfully contribute to our understanding of innovation diffusion is not new (Hägerstrand, 1953; Pred, 1977). While the EEG research programme has so far focused extensively on the introduction of novelty by means of innovation, it has left little room for both theorizing and empirical research into the diffusion of technologies. However, as Hägerstrand (1986/1991) has emphasized, innovation and imitation are, in reality, clearly coexistent, and may even be interlinked; in a knowledge-based society, cumulative knowledge and knowledge diffusion are of undeniable importance. In particular, three article streams could

benefit from a more explicit link to the diffusion ideas of time–geography and the bundles in which innovation diffusion take place: contributions on intra-firm labour mobility (Boschma, Eriksson, & Lindgren, 2008; Eriksson, 2011), inheritance theories and spinoffs (Buenstorf & Klepper, 2009; Dahl, Østergaard, & Dalum, 2010), and knowledge spillovers associated with locational environments (Audretsch & Feldman, 1996; Frenken, Van Oort, & Verburg, 2007).

Lastly, time–geography offers a way of thinking about economic complementarities in the perspective of time–space coordinates. In fact, the ideas concerning historical development blocks and their complementarities and bottleneck effects (Dahmén, 1988) may also inform analyses of cluster evolution and regional development paths where, at times, the absence of complementary resources limits economic change, co-evolution and path-dependent development (Boschma & Fornahl, 2011; Hervas-Oliver & Albors-Garrigos, 2014).

## Theories of abstract history and lessons from real history: economic history

When the approach was initialized, the first EEG contributions were inspired to a considerable extent by the works of economic history (Boschma, 1997). In particular, the concept of windows of locational opportunity (Boschma, 1997; Storper & Walker, 1989) added to a geographical understanding of major shifts in the location patterns of economic activities over the course of history. Since then, however, empirical EEG has drawn relatively little on economic history works and works on long-term technological and institutional change. For EEG particularly, the economic history literature can provide evidence of the following:

- Technological development opening up new potential location sites.
- Technological development changing the character of time–geography constraints, enabling new or different bundles to be formed.
- Institutional development changing the character of time–geography constraints.
- Region-specific historical contingent factors affecting the core EEG mechanisms of variation, selection and retention.

The lessons that can be learned pertain both to abstract and real history. In terms of the first point above, technological change can enable new locational sites to become available. For example, the integration of the electricity grid, or even such a mundane thing as the expansion of a efficient road system (Berger, Enflo, & Henning, 2012), may completely change the prerequisites of location, enabling regions to participate in new divisions of labour and specialization.

Technological and institutional development can also change the character of time–geography constraints (the second and third points above). Historical accounts cover both the abstract and real aspects of these changes. Abstract accounts, for example, theories about long-waves, techno-economic paradigms, or technological shifts (Freeman & Louçã, 2001/2010; Freeman & Perez, 1988; Freeman, Clark, & Soete, 1982; Schön, 2010; Schumpeter, 1939; Van Duijn, 1983), suggest how technological and institutional features co-evolve to shape growth patterns centred on a couple of core innovations and their diffusion. These could also be expected to affect regional development (Henning, Lundquist, & Olander, 2016; Lambooy, 2010; Lundquist & Olander, 2007). While these contributions provide a stable framework, to which the myriad of developments in real history can be related, they are also contested. Nevertheless, the evidence of Enflo and Henning (2016) suggests that there have been 'eras' of regional economic development that have been dominated by specific sets of spatial growth patterns. The development of an evolutionary macro-account of regional growth eras would help one to position in-depth accounts of regional change in a more encompassing history of regional changes.

Historically contingent factors may also affect variation, selection and retention in particular regions. Examples of this include specific regional policies favouring economic evolution, or the long-term growth of regionally unique institutions of particular kinds. Uncovering this calls for contextual knowledge of historical regional traits. While Boschma (2017) called for greater 'geographical wisdom' in explaining regional diversification, we would like to call for more 'temporal wisdom' in interpreting results from an evolutionary angle. There are, of course, analyses of global or international trajectories (e.g., Pollard, 1981, 1997); however, sources of the temporal wisdom often vary nationally, or even regionally. Notable examples include the detailed descriptions of Smith (1949/1968), Pollard (1992), Magnusson (2000) and Schön (2010). Such accounts often include, if not fully fledged regional analyses, at least some regional considerations (Pollard, 1981, pp. 111–123).

In the myriad of contextual evidence of the histories of individual regions, the challenge is, rather, what evidence to look for. Here, inspiration can be drawn from previous work done in geography. Storper (1997, p. 27) suggests three dimensions in his 'holy trinity of regional economies', that is, technology, territories and organizations. Perhaps more operationally relevant, Doussard and Schrock (2015) suggest four types of contingencies in their study of the US computer industry and its locational change, that is, firm, technology, place and market. Regional historical specificities of these, in real history, may serve as an underlying sorting scheme for the contingent factors affecting variation, selection and retention in regions.

## Methodological challenges facing longitudinal regional research

Making EEG more historical also involves considerable technical and methodological challenges. An encompassing view of these can be constructed by considering the methodology literature in spatial sciences. Table 2 highlights four particular areas of challenge. The first, covering

**Table 2.** Assessment guide for historical studies of evolutionary economic geography (EEG), with some examples.

| | Problem | Examples |
|---|---|---|
| 1 | Content changes | Changes in the content of industries, meaningful regional definitions |
| 2 | Modifiable period problem | Outcomes change as periods are redefined |
| 3 | Temporal boundary problem | Outcomes change as slightly longer time periods are considered |
| 4 | Time characteristics of data | Time-series characteristics, e.g., the presence of trends |
| 5 | Historical validity | Unreliable or selective secondary data; difficult to evaluate validity |

Sources: Inspired by Cloke et al. (2004) and Rogerson (2006).

challenges to research posed by *content changes* in statistical nomenclatures, includes alterations in the content of descriptions (e.g., industries) (Cloke et al., 2004), and changes in the meaning of real distance and regional definitions over time. The first has been a natural point of discussion in the longitudinal empirical work of EEG, thus far highlighted mainly in the context of linking industry time-series (e.g., Eriksson et al., 2016) and making regional measurement categories consistent over time (e.g., Kogler, Rigby, & Tucker, 2013). The latter is a paramount issue in EEG. As time–geography provides a basic notion of how time–space coordinates change, and daily prisms develop across time, EEG could start considering this issue at the same level of detail it has been doing with other content changes, and maybe even in a dynamic sense.

In addition, Rogerson (2006) highlights four issues in spatial statistical analysis, that is, the modifiable areal unit problem, boundary problems, spatial sampling procedures and spatial dependence. Three of these can be transferred to a temporal context as well (Table 2). A *modifiable period problem* originates in the often-reoccurring ambition of delimiting structural periods in EEG, for example, phases of industrial life cycles (Neffke, Henning, et al., 2011) or long waves of technological development (Lambooy, 2010; Schön, 2010). More specifically, the problem has to do with: (1) where the boundaries of the time periods in succession models should be placed; and (2) the length of the periods. Because periods can hide internal dynamics, results may be dependent on the actual limits set and undermine the robustness of estimations, creating the modifiable period problem.

The *temporal boundary problem* arises from the definition of the complete period of investigation: A longer time perspective and inclusion of more data from adjacent periods can, in some cases, lead to different conclusions, especially if the period immediately before or after the period under study includes a crisis. Unfortunately for many EEG scholars, the answer to such data considerations is that the boundaries of the investigated periods are often determined by data availability. *The time characteristics of data* (e.g., the autocorrelation of error terms or trends) impact, for example, the dependence on observations over time and are well-known econometric aspects in the time-series analysis literature (Bowerman & O'Connell, 1993; Wooldridge, 2013, part 2). This problem can be remedied using appropriate econometric methodologies.

In the present discussion, it might seem that the methodological problems of longitudinal research mainly affect quantitative studies. This is not the case. As time and history are increasingly also being considered in case study and qualitative research into regional economies, a *historical validity problem* is arising. While studies of the historical development of clusters, for example, must rely on secondary data, it is often difficult to assess the validity of the material, and to evaluate how selective it is. Here, many methodological lessons can be learned from the history discipline concerning the critical use of historical sources and, above all, where to find them. Retrospective studies that use primary data (e.g., interviews about the past) also wrestle with particular problems. Apart from all the challenges normally involved in doing interviews, statements about the past risk being biased because the individual's memories may be selective, and interpretations of the same empirical situations may vary to a surprising extent. So far, EEG has developed few answers to, or strategies that meet, such concerns, with empirical case studies seeming to remain largely silent on these methodological issues. One exception is Pike et al. (2016), who discuss how context-handling and comparative methods from geographical political economy can be used in EEG. In addition, even though the historical sciences today are engaged with much the same quantitative and qualitative methods as the social sciences in general, one of the main strengths of historical science is still source criticism and insights into what kind of methodologies can be used to generate reliable knowledge about the past using less-than-optimal data, solutions to some methodological issues of a historical EEG can surely be sought here (Jarrick, 2005; Nilsson, 2005).

## CONCLUSIONS

Time is inherent to the EEG approach. Compared with other approaches, EEG is unique in trying to take the golden middle road between neoclassically inspired location studies and institutional economic geography (Boschma & Frenken, 2006), but also between abstract time and history, in endeavouring to explain how regional economies work. Yet, empirically, it seems that EEG does not have any more time or history than could be expected from using just any approach.

Scholars have started to note this drawback of the evolutionary research programme and are now increasingly engaging with historical perspectives. This development is very promising, but it is not without hurdles. Even with new time-series and longitudinal case study data, certain specific theoretical and empirical issues remain to be solved. Drawing on the works of time–geography, a more precise representation of how the introduction of novelty, selection and retention is affected by changes in restrictions

over time can be created. From economic history, EEG can draw on insights about both abstract and real history in order to apply a greater degree of historical wisdom in interpreting the results. Lastly, a range of empirical research problems can be tackled by learning from the general methodology literature, but also from the methods of history. While these adjacent literatures offer immediate complementarities, other adjacent evolutionary sciences may also, of course, hold interesting theoretical and methodological lessons for longitudinal EEG.

Much work is in progress, suggesting that a deepening of the historical perspective is the next natural step to advance the EEG approach further (Martin & Sunley, 2015; Pike et al., 2016). It would seem to be a core challenge for future EEG to find out, in the words of Doussard and Schrock (2015), 'what kind of history matters, and when' (p. 163). Using insights from time–geography, economic history and the methodological literature on longitudinal research, it is time to take the next step toward achieving this in EEG.

## ACKNOWLEDGEMENTS

The author thanks three anonymous reviewers, the editor, Claes Alvstam, Kerstin Enflo and participants at the Center for International Business Studies (CIBS) seminar in Gothenburg, Sweden, for constructive comments that helped to improve the paper significantly.

## DISCLOSURE STATEMENT

No potential conflict of interest was reported by the author.

## FUNDING

This work was supported by the Länsförsäkringar Alliance Research Foundation (Länsförsäkringars forskningsfond) [Svensk regionalekonomisk utveckling och omvandling].

## NOTES

1. There is also a tradition labelled historical geography, leaning more explicitly toward the discipline of history (Baker, 2003).
2. For overviews of the conceptual foundations of EEG, see Essletzbichler and Rigby (2007, 2010) and Essletzbichler (2012).
3. Coordinated by the Department of Human Geography & Urban & Regional Planning, Urban and Regional Research Centre Utrecht (URU), Utrecht University (see http://econ.geo.uu.nl/peeg/peeg.html).
4. See https://www.nappdata.org/napp/.
5. The work of Bathelt and Boggs (2003) was also conceptually important.

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