Path dependence

Jinn-Yuh Hsu
Yu-Kai Liao
National Taiwan University

The concept of "path dependence" emphasizes that the set of decisions one can make is influenced by the decisions one has made in the past. More specifically, it argues that certain historic events would disproportionately cause later conditions. One of the most well-known examples, offered by economist Paul David, is the adoption of QWERTY keyboard. Although the layout of QWERTY keyboard is not the most efficient one in comparison to many other keyboard models that have existed in history, it has become the industrial standard (David 1985). Paul David explained that this is because in the initial stage of the development of typewriters, most typists were trained to learn and memorize the arrangement of the keys in the QWERTY layout. And, as it is difficult to change typists' habit, more and more typewriter manufacturers adopted the QWERTY keyboard. As a result, the less efficient keyboard model became the mainstream. In short, path dependence emphasizes that economic configurations cannot be explained solely by some timeless logics such as cost or benefit; history matters in the shaping of economic structures.

Since its introduction in the late 1980s, the concept of path dependence has undergone several rounds of elaboration and modification. One important contribution was made by economist William Brian Arthur, who, in *Increasing Returns and Path Dependence in the Economy* (1994), proposed four concepts – large initial fixed set-up costs, dynamic learning effects, coordination effects, and self-reinforcing expectations – to further elaborate on the relationship between history and the economy. "Large initial fixed set-up costs" refers to the fixed capital that a company has to expend prior to the production of a particular product. To cover this cost, most companies, in the initial stage of the production at least, will focus on increasing production outputs, thus bringing inertia to changes that may make the production process more efficient. "Dynamic learning effects" emphasizes the importance of learning by doing and learning by interacting, which would increase human capital. "Coordination effects" argues that cooperation between firms confer advantages to going along with other firms taking similar actions. Lastly, "self-reinforcing expectations" refers to the situation where increased prevalence of a particular product, technology, or production practice enhances beliefs of further prevalence. As a result, more suppliers and consumers would invest in the common standard, and products will fulfill the expectation and reduce the risk of investing.

David's work on the economics of technology (the adoption of the QWERTY keyboard being his most famous example) and Arthur's thesis about increasing returns together inspired a generation of economists to investigate how economic structures are shaped by historical accidents and contingencies. This strand of scholarship is often referred to in literature as *evolutionary economics* (EE). It is also worth noting that in economics insights from path dependence theory encouraged some scholars to bring geography into the study of the

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economy. In *Geography and Trade*, for example, Paul Krugman (1991) points out that increasing returns is one of the determining factors behind trade. This approach to trade is in sharp contrast to Ricardo's notion of comparative advantage, upon which mainstream economics has been based on. In economics, literature works by Paul Krugman and his followers are often referred to as *new economic geography*.

Box 1

The case that Krugman examined was the formation of the Rust Belt in the United States. He developed a simple model that shows that the interaction of increasing returns, transportation costs, and demand can give rise to the spatial concentration of the manufacturing sector. In the early history of the United States, where manufacturing was marked by few economies of scale and where transportation was costly, no strong geographical concentration could occur. As the country began its industrial transition, manufacturing grew in areas that contained most of the agricultural population outside the South. As this economy of scale increased, transportation costs fell, and the share of the population in nonagricultural occupations rose. As a result, the initial advantage of the manufacturing belt was locked in.

The influence of path dependency theory on other social sciences disciplines – human geography, sociology, and political sciences in particular – has been no less significant than it has been on economics. In human geography, the introduction of the path dependence theory is closely associated with the emergence of the literature of *evolutionary economic geography* (EEG), which is our primary interest here.

Evolutionary economic geography

Evolutionary economic geography concerns the evolution of economic landscape, or the transformation of the spatial organization of production, distribution, and consumption. Two lines of inquiry characterize this body of research. The first is the study of the evolution of economic landscape in a given location. For example, in his study about the coal and steel industrial complex in Rhur, Grabher (1993) identified three types of "lock-in" – functional (based on hierarchical relations between firm), cognitive (consisting of a common world-view), and political (a thick and dense institutional structure that hampers restructuring) – to explain why the region become inflexible, unable to absorb new ideas, and ultimately unable to respond to competition.

The second is the study of the novelty of economic landscape across locations. Here, the scholar's primary interest is in the spatial logic of the emergence of new industries. Boschma (1997), for example, argues that the requirements of newly emerging industries are often discontinuous with the environment of pre-existing industries. This is because previous local context does not necessarily provide an advantage to stimulate for the development of new industries. The implication of this proposition is that regions that are lagging behind are often more attractive to new industries. The case that Boschma used to develop this argument is the transformation of industries in Belgium since the nineteenth century. He carefully examined the locational patterns of five industries: coal-based iron making, cotton, electronic engineering, automobile, and microelectronics. He found that the development of electrical engineering and automobile industries (often referred to as the "second industrial revolution") require specific technological knowledge, skill, and capital.

These requirements are very different from those of coal-based iron making (which required proximity to the coal and ore mines) and the cotton industry (which required a pool of experienced labor and skilled entrepreneurs). As a result, the electrical engineering and automobile industries preferred to locate in particularly old industrial regions or lagging regions that could provide the specific technology knowledge, skill, and capital.

Without doubt, prior to Boschma's research, economic geographers had investigated the issue of industrial locations. In *The Capitalist Imperative,* Michael Storper and Richard Walker (1989), for example, proposed the concept of "windows of locational opportunity" to bring political economy into industrial location theory. They pointed out that the geography of capitalism is uneven and inconstant. Through technical innovations, organizational changes, and labor intensification, capital is able to escape from the past and creates a new industrial landscape. This means that new industries would not necessarily develop in established industrial regions. What is new about Boschma's research, however, is that it points out that every place has its history, and the history leads to different regional capacity and possibility. An analysis of the spatial logic of the emergence of new industries thus has to consider historical contingency.

Between EE and EEG, there is thus a clear difference in terms of research agenda. Evolutionary economic geographers investigate how place dependence (as a form of path dependence) shapes the trajectory of economic development, an issue that is largely absent in the scholarship of evolutionary economics. Such a unique research focus reflects an important theoretical stance that has been widely accepted among human geographers: that space and place are not just stages upon which activities and events occur, but also (and more of) driving forces that bring about social, economic, political, and cultural transformations.

Within geography, EEG is often seen as a critic to *institutional economic geography* (IEG), which also studies the spatial logic of industry. IEG attempted to bring sociocultural dimensions into economic geography. Researchers regarded institutions as carriers of geographical–historical context and sociocultural product. Ash Amin and Nigel Thrift (1995), for example, use the concept of "institutional thickness" to emphasize the importance of institutional decisions, such as strong institutional arrangements, high level of interaction among institutions, well-defined structure on institution, collective mobilization, and the spatial organization of industries.

For them, the transformation of industrial landscape cannot be understood without attention to instructional transformations. EEG criticizes the concept of institutional thickness for lacking a clear definition and being difficult to measure. In general, there are two main

Box 2

There are three kinds of institutionalism: rational choice institutionalism, sociological institutionalism, and historical institutionalism. Rational choice institutionalism describes institutions as products of competitive selection. Sociological institutionalism argues that institutions are shaped by social legitimacy and collectively cognitive maps. Lastly, historical institutionalism assumes that institutions are produced through social, economic, and political relationships. The work by Ash Amin and Nigel Thrift attempted to bring geography into the study of the institution.

differences between the two approaches. First, while EEG is concerned about the dynamics of the changing economic landscape during a particular period of time, IEG is less concerned with the issue of change. Second, while EEG emphasizes the importance of the routines of firms (which are shaped by past experiences and learning by doing), IEG argues that communities and territories produce a macro-context, which influences on the routine of firms and guides the firms to work.

Without doubt, attention to history, or inquiries about spatial transformation through time, existed in human geography long before the introduction of path dependence theory. The Marxist turn in human geography during the 1970s had drawn many scholars to the approach of geographical–historical materialism, which views space as the product of historical processes. In the broadest sense, Marxist geographers see an existing spatial structure (e.g., uneven development between the developed world and the developing world) not as a state of equilibrium brought about by some abstract economic laws (e.g., the invisible hands of supply and demand) but as the product of the dynamics of capitalism. David Harvey (1982) and Neil Smith (1984), for example, emphasize uneven development as an inevitable condition under capitalism. To solve the inherent problem of overaccumulation, capitalists have to constantly create profitable terrains for surplus production. This can be achieved through, for example, induced unemployment, technological innovation, immigration, or exporting capital. If all these methods failed, capital accumulation is blocked and capital can be devalued or physically destroyed. The spatial implication of this dynamic is that development in one place is often interconnected with underdevelopment in another place. Yesterday's boomtown may thus become a ghost town tomorrow (as in the case of Detroit), and previously deprived regions may become new centers of production (as in the case of post-Mao China) or speculation. Along a similar line, Doreen Massey, whose research focuses on the restructuring of industries in postwar Britain, drew attention to the spatial division of labor (Massey 1984). Her main argument was that the economic landscape inherits the legacies of its past development and that these legacies exert an influence on its present and future development.

There exists, however, one profound difference between the ways in which Marxist geographers and evolutionary economic geographers treat history. While Marxist geographers' concern is the meta-narrative of political economy, many evolutionary economic geographers, as Martin and Sunley (2010) pointed out, build their research upon universal Darwinism, complexity theory, or panarchy theory (Boschma and Frenken 2006; Martin and Sunley 2006). In other words, not all the evolutionary economic geographers are concerned with the political economy.

Geography's contribution to path dependence theory

The relationship between human geography and path dependence theory is not unilateral. While path dependence theory inspires geographers to ask new research questions, geographers have also, in turn, helped shape the contour of the theory. One good example is Martin and Sunley's (2006, 2010) critique and modification of the basic path dependence model.

The initial path dependence model developed by Paul David and William Arthur was composed of four difference phases: *pre-formation*, *path creation*, *path lock-in*, and *path dissolution* (Figure 1). The pre-formation phase, also often called *multiple equilibria*, refers to the situation in which a lot of choices and possibilities are available

Box 3

Within institutionalism, there are also discussions about incremental changes. In *Explaining Institutional Change: Ambiguity, Agency, and Power*, James Mahoney and Kathleen Thelen (2009) argued that significance of gradual evolution of institutions should be considered and the endogenous forces are also the driving force. Mahoney and Thelen viewed institutions as distributional instruments that raise tensions between different groups. Different actors will compete or ally with others to create, maintain, or revise institutions according to their interests. Actors change institutions through four modes of institutional change – displacement, layering, drift, and conversion. The occurrence of these four modes of institutional change is dependent on political context and institution form not only directly induces institutions to change but also shapes the emergence of the type of dominant change-agent and the strategies which the agent adopted.

(or could be discovered). The path creation phase refers to the situation in which a certain path is formed as the result of random events or historical accidents, and along the path new technologies, organizations and institutions are developed. The path lock-in phase refers to a rather stable condition (as the result of network externalities and increasing returns) in which a certain economic system reproduces (or being locked in) the conditions of the chosen path. Lastly, the path dissolution phase refers to the destabilization of the lock-in and the decline of the path as the result of some "external shocks," such as innovation

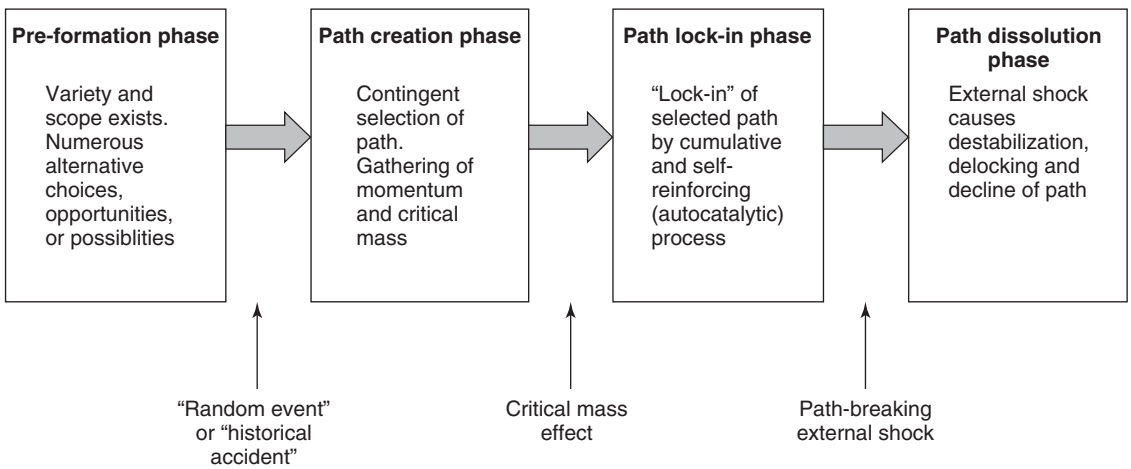

Figure 1 The basic path dependence model developed by Paul David and William Arthur. Source: Martin and Sunley (2010).

of technology, competition, or institutional change.

Martin and Sunley criticized the basic path dependence model for being, first of all, not evolutionary enough. They pointed out that, in the basic model, history matters only in the initial stage. The model implies that there would be a state of equilibrium once an economy is locked in certain practices. Martin and Sunley insisted that the evolution of an economy should be seen as a continuous process rather than a series of states of equilibrium. Second, they questioned the presumption that there exists a phase of development that is free of pre-existing conditions (as how the phase of pre-formation was described). Martin and Sunley emphasized that economic structures are always shaped by pre-existing technological structures, knowledge, and competence. Lastly, they criticized the emphasis on the influence of "external shocks," which, according to the basic model, would result in the decline of a certain path. Martin and Sunley pointed out that the concept of "external shock," on the one hand, denies the possibility that endogenous forces can also lead to significant changes while, on the other hand, it fails to take into account incremental changes and modifications (which can be endogenous or exogenous).

The alternative model that Martin proposed emphasizes that the environment for the emergence of new technologies and industries can

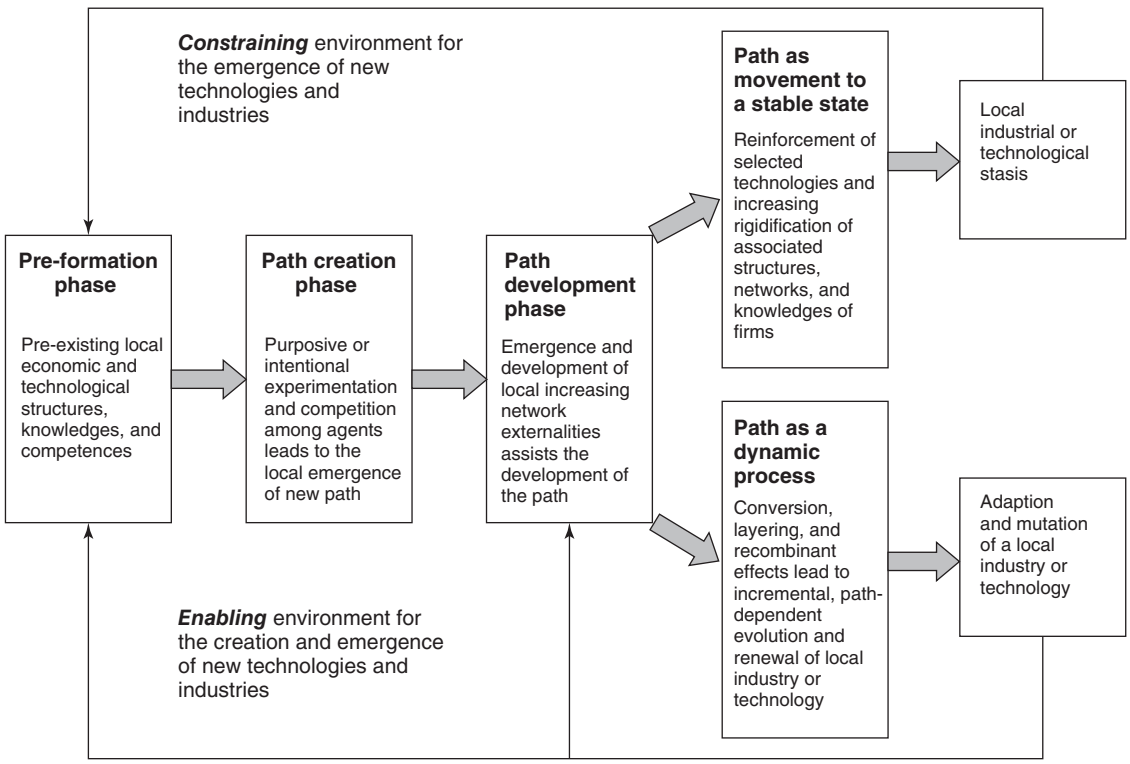

Figure 2 Regional path dependence model developed by Martin. Source: Martin (2010).

be either *constraining* or *enabling* (Figure 2). A constraining environment would often lead to a "static state," where selected technologies and existing structures and knowledge of the firms tend to last and reproduce themselves until there comes an internal or external shock. An enabling environment, in contrast, would make a selected path more dynamic. Here, Martin elaborated how *layering*, *conversion*, and *recombination effects* would lead to incremental, path dependent evolution and the renewal of industries or technology. The *layering effect* refers to the addition of new rules to an existing institution, which allows the institution to change incrementally. The "conversion effect" refers to the addition of new rules (or the abolishment of the old) that would convert an institution's original logic of operation. Lastly, the "recombination effect" argues that "any particular existing social-political-economic structure is a system of resources and properties that actors can recombine and redefine to produce a new structure" (Martin 2010, 15).

Martin used the case of the development of the high-tech cluster in Cambridge, UK, to further elaborate the proposition that economic evolution is a *process* instead of a series of states of equilibrium. In the early 1960s, the Cambridge consultant proposed to recruit academic staff from the University of Cambridge to industry. The result of this action was the development of a high-tech cluster in the region, which includes computing and science instrument, software, and bio-tech companies. The formation of this cluster greatly contributed to the region's economic growth. Based on this case, Martin argues that path creation frequently emerges from existing industrial regions, which allows innovation to happen. Innovation thus is place-specific and locally contingent rather than accidental or random.

SEE ALSO: Institutions and development; New cultural geography

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