Chapter 3

The Modeling Tradition

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As part of a widespread engagement with contemporary cultural and social theory, many economic geographers are abandoning the search for analytical or "general" explanations of the processes determining the evolution of the economic landscape in favor of contextual or "local" explanations that are designed to take account of the complex construction of societal processes. In the wake of this broadly defined social and cultural turn in economic geography, it is now conventional to conceive of the modeling tradition as part of an historical legacy resulting from a particular set of cultural and institutional practices that constituted the quantitative and theoretical revolution of the 1960s (Cloke et al., 1991; Barnes, this volume). This historical moment consisted of a distinctive set of presuppositions about the way in which the social world is constructed (ontology) and how we know that social world (epistemology). It is commonly supposed that, within the modeling tradition, the objective is to account for observed patterns of spatial economic activity using mathematical models and quantification. In addition, these mathematical models should be grounded in the competitive economic processes that operate between individual producers and consumers.

The supposition that we should employ mathematical models and quantification to reveal the spatial configuration of the economic landscape finds its rationale in a *positivist* conception of science (Johnston, 1986). According to this conception of inquiry, our knowledge of the world is grounded in experience or observation, and justified through a process of empirical validation. Empirical validation, or testing, can entail either corroborating the truth (confirmation) or establishing the falsity (falsification) of our mathematical models on the basis of empirical evidence (Giere, 1984). In practice, model validation has often consisted of analyzing map patterns in order to establish general principles (morphological laws) governing the structure of the economic landscape (Harvey, 1969). Worse still, for many economic geographers, the modeling tradition has come to be associated with endless statistical analyses that are supposedly conducted in the "search" for empirical relationships between some phenomenon and a set of potentially "explanatory" variables (Massey and Meegan, 1985).

Whilst a variety of mathematical models have been proposed for economic geography, the history of modeling has been dominated by assumptions derived from *neoclassical economics*. According to neoclassical orthodoxy, economic outcomes are the result of the rational action of individuals, operating through a market mechanism to produce optimal outcomes that achieve an equilibrium (i.e. a position such that no individual has an incentive to change his/her current decision). In economic geography, neoclassical economics has become translated into the supposition that observed patterns in the economic landscape are the outcome of competitive processes operating between individual consumers and producers.

For many, the quantitative and theoretical revolution has now passed. In the last thirty years, both positivism and neoclassical economics have been subject to a widespread set of criticisms that question the degree to which mathematical models are capable of providing either understanding or explanation of the evolving economic landscape (Sayer, 1984; Gregory, 1978). The resulting consensus appears to be that the modeling tradition should be consigned to the dustbin of intellectual history, to be replaced by an array of approaches encompassing Marxian alternatives, feminist theory, social and institutional approaches, and postmodern interventions (cf. subsequent chapters in this section).

In this chapter, I attempt to provide a more sympathetic overview of the place of modeling within contemporary economic geography. My objective is to provide a constructive rather than destructive critique of contemporary modeling approaches. My hope is that a new generation of economic geographers will be encouraged to take up the challenge of developing model-based explanations in economic geography. To justify a claim for the modeling tradition in economic geography, I critically examine both the philosophical and social theoretic foundations of model-based explanations. Central to my claim is the proposition that it is possible to reject both positivism and a vision of society based on neoclassical economics without rejecting a modeling approach to economic geography.

Model Design

Modeling appears to be central to almost all aspects of contemporary scientific activity. Modelers represent the world to themselves and others through the use of their models. In contemporary discourse, it is conventional to argue that models are "idealizations," "abstractions," or "simplifications" designed to account for some aspect of (social) reality (Casti, 1998; Clark, 1998). For any actual geographical system, it seems plausible that the location of economic activities will depend on the space of flows connecting and helping to define those locations, and vice versa. Further, it seems likely that changes in the location of economic activities may depend on the existing space of flows, and changes in the space of flows may depend on the existing location of economic activities. The complexity of the relationship between spatial processes, spatial interaction, and spatial structure suggests that it is difficult, if not impossible, to provide an explanation for all aspects of the evolving economic landscape. Indeed, it is because the geographical world is complex that we need to build relatively simple models to understand how these systems operate. Historically, modelers have attempted to control for the complexity of the evolving economic landscape by developing: (i) models of location for a given space of flows;

(ii) models of spatial interaction between a fixed set of locations; and (iii) models of simultaneous location and allocation of economic activities (Bennett and Wilson, 1985). However, recent research has shifted towards developing models that both account for the mutual temporal adjustment between spatial structure and spatial interaction, and involve some underlying dynamic spatial process or mechanism (Bennett et al., 1985).

Questions regarding which aspects of an actual geographical system should be included in a model are part of *model design*. As part of model design, it is common to use analog models to compare and describe an unfamiliar system in terms of the properties of a familiar model. The objective in using analog models is to establish relationships of similarity between two different model systems rather than between a model and social reality. In economic geography, examples include: the use of Newtonian mechanics as a model for the flow of people, goods, and information (Wilson, 1970); the use of electrical circuits as a model for spatial price competition (Sheppard and Curry, 1982); and the use of crossword puzzles as models for the evolution of spatial economic systems (Curry, 1989).

In contrast, and despite differences in the form of representation, material and logical models share the common feature that they are employed to establish relations of similarity between a model and an actual system. Material (or experimental) models are some of the first models that we encounter in economic geography. They consist of physical (hardware) or scaled (iconic) representations of actual systems. For example, in industrial location theory, there is the Varignon frame that makes use of weights and pulleys as a mechanical model to determine the optimal location for an industrialist pulled between various raw materials sources and markets. In contrast, logical models employ a more formal language of representation that, typically, consists of a mathematical or computational language (e.g. Aristotelian logic, differential calculus, FORTRAN). The essential feature of formal languages is that they consist of a set of abstract symbols assumed to be true without proof (axioms) and a set of rules of logical inference for combining those symbols (grammar, syntax) to generate new symbols and symbol strings (theorems). Using the rules of logical inference, it is possible to explore the properties of the stipulated model. However, the rules of logical inference do not establish the degree to which the model system corresponds to the relevant aspects of the modeler's world.

To ground our discussion, consider one of the simplest models we encounter in economic geography: the (Keynesian) economic base model. Despite its shortcomings, this model continues to form the basis of many contemporary approaches that seek to determine the level of regional economic activity (Armstrong and Taylor, 1993). In its simplest form, an economic base model consists of an accounting identity, relating regional income and expenditures, and behavioral postulates, linking consumption and investment expenditures to regional income (output). The accounting identity (or budget equation) states that regional income (Y) is equal to aggregate consumption expenditures (C) added to aggregate regional investment expenditures (I). This relationship is necessarily true, being determined by income and expenditure accounting conventions. A minimal requirement for a mathematical model to account for some aspect of the evolving economic landscape is that such a model should embody a process or mechanism of change. In other words, our model needs to be dynamic. The simplest way to introduce dynamics into the regional economic base model is to assume that consumption at time t (C_t) is a proportion (β) of income in the previous time period (Y_{t-1}). In addition, aggregate investment expenditures at time t ($I_t = \mathbf{I}$) are assumed to be determined by factors outside the model. That is, both aggregate income and aggregate consumption are assumed to be endogenously determined in the model while aggregate investment is determined exogenously. Mathematically, this model constitutes an accounting identity, a function linking income and consumption (consumption function), and a constant determining the level of investment (investment function):

$$Y_t = C_t + I_t \quad \text{(Accounting identity)} \tag{3.1}$$

$$C_t = \beta Y_{t-1} \quad \text{(Consumption function)} \tag{3.2}$$

$$I_t = \mathbf{I} \quad \text{(Investment function)} \tag{3.3}$$

Substituting the consumption function (3.2) and investment function (3.3) into the accounting identity (3.1) and solving for regional income Y_t, yields an equation linking current and previous aggregate regional income:

$$Y_t = \beta Y_{t-1} + \mathbf{I} \tag{3.4}$$

In order to determine the trajectory of aggregate regional income, it is necessary to have information on the level of regional investment ($\mathbf{I}$), the responsiveness of consumption to income (β), and the level of aggregate income at the beginning of the dynamic adjustment process, t = 0 (Y_0). To illustrate the derived properties of this model, consider a simple numerical example in which I = \$10,000 and that Y_0 = \$20,000. If the consumption function (equation 3.2) is to be economically meaningful it is necessary that consumption expenditures are positive but less than income ($0 < \beta < 1$). Accordingly, arbitrarily set $\beta = 0.6$. An equilibrium level of regional income (Y_E) is defined by the condition that current income is equal to income in the previous period ($Y_E = Y_t = Y_{t-1}$). Setting the current income level equal to the immediately previous income level and solving equation (3.4) in terms of the equilibrium level of income yields $Y_E = \mathbf{I}/(1-\beta)$. In this numerical example, the equilibrium level of regional income is \$25,000. Figure 3.1 illustrates the resulting dynamic adjustment of regional income with respect to this equilibrium by plotting the trajectory of income against time. Note that, in this numerical example, the dynamics of regional income are *stable* in the sense that, from an initial position of disequilibrium, the model converges monotonically to an equilibrium. Provided the responsiveness of consumption to income is positive but less than unity, it can be demonstrated that the trajectory of regional income will converge monotonically to an equilibrium regardless of the initial level of income (Shone, 1997).

To understand the process of model design in more detail, it is necessary to unpack the way in which this model has been constructed. As with any model, the economic base model is formulated using a set of assumptions about the way in which the actual system operates. In arriving at a simplified representation of an evolving economic landscape, a decision has been made on which elements to include in the model. While the model will include variables and relationships that are hypothesized to hold in the actual system being modeled, it will also include assumptions that are false. For example, the economic base model usually assumes that: (i) there

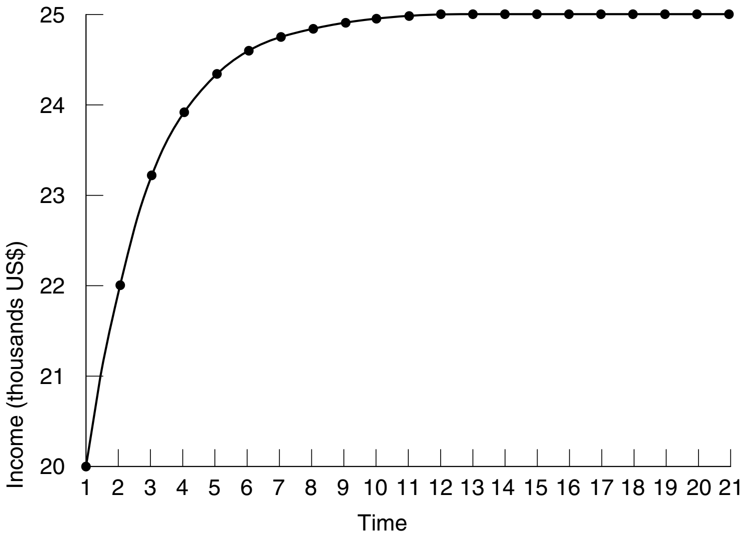

Figure 3.1 Monotonic convergence in a simple linear model
Source: Author

is no trade between regions; (ii) spatial economic behavior can be represented by aggregate variables; (iii) there is a constant relationship between consumption and income; and (iv) aggregate investment does not depend on either income or consumption.

Employing simplified assumptions, which are known to be unrealistic, is justified when it is believed that the omission of more complex variables has only a negligible impact on the operation of the actual system. For example, trade with other regions may be negligible. However, false assumptions can also be employed as heuristic devices when exploring the logical properties of a model. These assumptions can be relaxed in subsequent investigations. The use of heuristic assumptions is an important part of model design in economic geography. For example, an isotropic surface, in which space is treated as a homogeneous and unbounded surface with the cost of movement on the surface being determined by a "distance friction" parameter, represents a powerful *ceteris paribus* or "other things being equal" assumption that is used to isolate the impact of transportation costs on location patterns in models of agricultural land use, central place models, and models of industrial location (Dicken and Lloyd, 1990).

Model Validation

While the selection of appropriate models is part of model design, evaluating the degree to which such a model captures some aspect of an actual geographical system is part of *model validation*. This entails establishing the grounds, if any, on which we are justified in the claim that our model is similar to the object being modeled. Depending on our philosophical orientation, model validation may be guided by the degree of correspondence between our model and social reality, the degree to which our model coheres with our belief system, and/or the utility of the model in solving problems (Laudan, 1990). In practice, the decision to accept a model as an adequate explanation can involve a wide array of sometimes conflicting methodological rules including model elegance, relevance, simplicity, theoretical plausibility, explanatory power, and predictive ability.

From the perspective of a modeling approach, empirical evidence provides a necessary but not sufficient condition for model validation. If the aim of modeling is to establish the degree of correspondence between a model and an actual geographical system, then this entails the assumption that empirical evidence reflects the actual state of some aspect of the social world. Alternatively, the link between a mathematical model and empirical evidence may constitute one way of evaluating either the coherence of our overall belief system or of corroborating the degree to which our model represents a useful problem-solving device. Regardless, model validation entails employing a suitably formulated modeling methodology in such a way as to bring empirical evidence to bear on the claims formulated in our mathematical model.

Broadly speaking, empirical evidence involves quantification and measurement. Accordingly, empirical evidence encompasses both direct sensory data and observations from sensory data that have been measured, however indirectly, using instruments and measurement tools. For example, in our simple economic base model, we would need to be able to quantify regional income and regional investment over a specified time period. How we choose to measure variables such as income and investment will depend, at least in part, on the prevailing conventions and measurement practices underlying income accounting (Shaikh and Tonak, 1994). Empirical evidence that can be successfully replicated using prevailing measurement conventions and practices may become accepted as a "fact" by members of an intellectual community. However, there is no foundational empirical basis from which we are able to construct knowledge of the evolving economic landscape. Rather, empirical evidence is subject to revision and, perhaps, later rejection in the light of changes in the prevailing set of conventions and measurement practices. It is in this sense that we think of "facts" as being theory-laden. The theory-ladenness of observation undermines the positivist ideal of grounding scientific explanation in a theory-neutral observation language (Chalmers, 1987).

In addition to the conceptual constraints that prevent the constructing of a secure empirical basis for knowledge, modeling faces practical limitations regarding the availability of relevant spatial economic information. Typically, we are trying to evaluate complex dynamic models of interdependent spatial economic systems using relatively aggregated cross-sectional data or relatively short spatial time series. In addition, important variables are either not measured or are unobservable. This includes measures of expectations, regional profitability, regional labor values, and regional input–output coefficients (Webber, 1987b; Dewhurst and Hewings, 1991). While there have been many innovative developments in measurement theory, it seems likely that the limitations of empirical spatial information are likely to remain – at least in the near future. Thus even if it is possible to design meaningful empirical tests to establish the validity of mathematical models, it may not be possible to implement such tests due to the limited quantity and quality of the empirical information that can be collected for spatial economic systems.

To confront a mathematical model with empirical evidence, we need a method for linking the "theory" to the "facts." In practice, this involves specifying an empirically estimable model derived from the mathematical model. Given the complexity of the evolving economic landscape, it does not seem plausible to aim for empirically estimable models that are capable of accounting completely for all of the features of our empirical information. The discrepancy between "theory" and "fact" is assumed to result from the set of non-systematic measurement errors, omitted variables, and approximations that are made when formulating the mathematical model. For example, an empirical specification of the dynamic economic base relationship is:

$$Y_t = \beta Y_{t-1} + \mathbf{I} + \varepsilon \tag{3.5}$$

Where ε is a random error term that is intended to capture the innumerable, but individually unimportant factors that have not been included in the model (Haining, 1990).

Once an empirical specification has been estimated, the resulting estimates can be used to evaluate the empirical claims of the mathematical model. This includes evaluating the economic behavior contained in the model, making forecasts about the future, and analyzing economic policy alternatives. For example, in the case of the dynamic economic base model, we can use empirical evidence to interpret and evaluate the properties of the dynamics of regional income. Specifically, we can estimate the equilibrium level of regional economic activity ($Y_E = \mathbf{I}/(1 - \beta)$) and test the stability properties of the dynamic adjustment process ($0 < \beta < 1$). In simple linear systems, we can make forecasts about the future and analyze alternative policy scenarios based on the rule that small changes in input (investment) will produce correspondingly small changes in the level of output (economic activity).

The dynamic economic base model (equation 3.5) assumes that the parameters β and **I** are constant over time and space, and independent of the level of consumption, investment, and income. That is, the economic base model represents a closed system in the sense that: (i) the stipulated relationships between inputs and outputs are invariant over space and time; and (ii) the parameters of the system are structurally invariant with respect to changes in the variables in the system (Sayer, 1992). Assuming that a dynamic system can be treated "as if" it is closed is to ignore both geography and history. Fortunately, recent developments in modeling approaches have taken their first steps towards treating space and time seriously. Places are treated as interdependent in the sense that the economic activities in one region may, at least potentially, influence the behavior of all other regions (Hepple, 1996). In models of "fast" and "slow" dynamics, the parameters of a model are allowed to vary over time and space, and in response to changes in the system variables (Bennett, 1979; Bennett and Haining, 1985). In addition, multilevel models are now being employed to account for both contextual differences and place heterogeneity (Jones and Duncan, 1996).

To recapitulate, the objective of employing empirically estimable models is to determine the validity of our mathematical models, make forecasts about the future, and evaluate policy alternatives. This involves confronting the conclusions that are deduced from the mathematical model with empirical evidence, using a suitably formulated empirical modeling methodology. Empirical modeling is not a simple process of confronting "theory" with the "facts." Rather, empirical modeling is a complex and iterative process involving the confrontation, and subsequent revision, of different types of theoretical information. In any given modeling situation we are attempting to evaluate our mathematical model, in conjunction with background knowledge, defined by the set of approximations and omissions that we make in specifying an empirical model. We cannot know for certain whether a lack of correspondence between our mathematical model and empirical evidence is due to the falsity of our mathematical model or the falsity of our background information. As a consequence, we cannot establish for certain whether our model is either confirmed or rejected by the available empirical evidence. The absence of a secure foundation for empirical evidence and our methods for establishing the truth or falsity of mathematical models undermines a positivist conception of inquiry. However, our inability to establish certain and complete explanations of the evolving geographical landscape does not imply either that mathematical modeling is impossible or that some modeling methodologies are no more useful than others. Rather, we can aim for conjectural knowledge, in which our modeling methodologies, mathematical models, and background information are always fallible and subject to continual revision (Musgrave, 1993).

Competing Model Designs

In economic geography, the development of mathematical models owes much to an historical legacy that is grounded in the classical models of agricultural land use (von Thünen), industrial location (Weber), and central place organization (Lösch, Christaller). In the early days of the so-called "quantitative revolution," the objective of accounting for observed patterns of spatial economic activity became translated into a search for geometrical patterns and morphological laws (Bunge, 1966). Typically, these geometric configurations were derived from the simplistic assumption that space can be treated "as if" it is an isotropic surface (Haggett, 1963). The search for spatial patterns and geometric laws lay mathematical modeling open to the charge of "spatial fetishism." That is, spatial outcomes are treated "as if" they are independent of the society within which they are embedded (Smith, 1981). While the assumption of an isotropic surface was undoubtedly fetishized by some researchers, it is more appropriate to consider it as an heuristic assumption, employed as part of model development, rather than a representation of social reality. In fact, relaxing the assumption of spatial homogeneity tends to destroy the elegant geometric patterns of classical location models.

Much of what passes for mathematical modeling in contemporary economic geography is played according to the rules of neoclassical economics. These rules stipulate that a mathematical model can be considered adequate if, and only if, it is possible to derive an equilibrium spatial configuration of economic activity from a foundation based upon individual optimization, constrained by social and spatial structures of production and consumption. In terms of the operation of individual spatial markets, in which firms pursue location and pricing strategies, the focus is on determining the configuration of prices, outputs, and profits that is optimal under conditions of either oligopolistic competition, monopolistic competition, or perfect competition (Nagurney, 1993). At the macro (regional) level, it is now common to employ models of monopolistic competition to determine optimal configurations of specialization and trade, urban and regional agglomeration, and regional economic growth (Krugman, 1991).

The assumption that the characteristics of spatial markets and regional economies must be deduced from the behavior of individual agents entails *methodological individualism*. In accordance with the postulates of neoclassical economics, economic geographers have extended methodological individualism by stipulating that agents must behave rationally, attempting to maximize a specified objective, subject to constraints. For example, individual producers are assumed to maximize their total profits, subject to resource constraints, and individual consumers are assumed to maximize their utility in accordance with their given preferences. If there exists a competitive mechanism coordinating the behavior of all producers and consumers, then the aim is to derive spatial configurations in which all producers and consumers are maximizing their specified objective. Importantly, such a derived configuration is considered to be optimal in the sense that, simultaneously, collective economic well-being is maximized.

The notion that an equilibrium spatial configuration represents an optimal condition provides justification for a vision of capitalism as a self-regulating system that promotes rationality, stability, and the equitable distribution of resources amongst members of society (Sheppard and Barnes, 1990). However, such an equilibrium is only of theoretical interest if it is stable, in the sense that it can be reached from a position of disequilibrium as time increases (cf. figure 3.1). Neoclassically oriented mathematical models tend to treat the dynamics of competition as an adjustment process in which the rational response of producers and consumers will tend to drive an economic system towards an equilibrium configuration. If a spatial economic system is converging towards an equilibrium configuration, then the dynamics of competition are unimportant relative to the equilibrium configuration of a spatial economy. This provides a rationale for the view that equilibrium analysis is a plausible theoretical entry point for modeling a spatial economic system.

It is well known that simple linear systems, such as equation (3.4), possess only a limited set of possible trajectories with respect to an equilibrium. Specifically, out of equilibrium the time path either diverges from an equilibrium or converges towards that equilibrium. In addition, out of equilibrium dynamics are limited to either monotonic or periodic trajectories with respect to an equilibrium level (compare the two upper panels of figure 3.2). In contrast, if the relationship linking inputs to outputs is nonlinear, then the long-run behavior of the system can be more complicated. For example, if we assume that current regional income depends nonlinearly on regional income in the previous time period (e.g. $Y_t = \beta Y_{t-1}(1 - Y_{t-1})$) then the trajectory of income is no longer limited to either converging to, or diverging from, an equilibrium. Figure 3.2 illustrates that, depending on the value of β, it is possible that the model either: (a) converges monotonically to an equilibrium level of income; (b) converges periodically to an equilibrium; (c) displays sustained periodic fluctuations of income; or (d) displays the type of aperiodic fluctuations that are characteristic of "chaotic" systems (Gandolfo, 1996).

If nonlinear relationships are plausible representations of the relationship between the inputs and outputs of spatial economic systems, then this raises the possibility that such systems are permanently out of equilibrium. In turn, this implies that

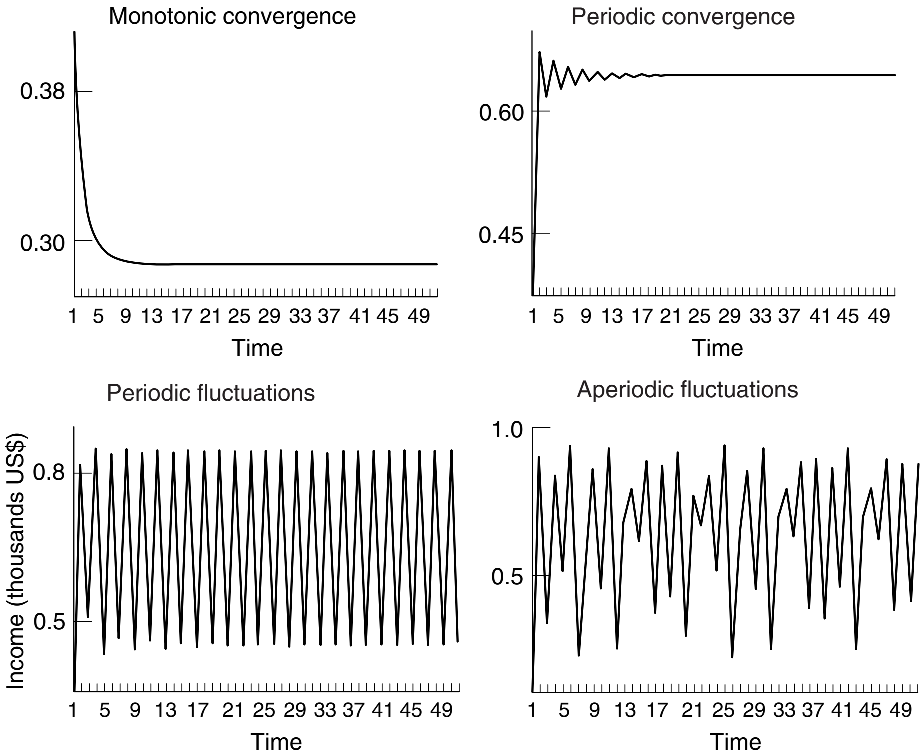

Figure 3.2 The qualitative properties of nonlinear systems
Source: Author

equilibrium analysis should no longer occupy the focus of analytical attention. Rather, equilibria should be relegated to theoretical reference points from which to triangulate the out-of-equilibrium dynamics of spatial economic systems. As a corollary, if the dynamics-of-competition do not tend to drive a spatial economic system towards an equilibrium configuration, then out-of-equilibrium dynamics may well be more important than the equilibrium configuration of a spatial economy.

All too often, the dominance of neoclassical economics has led to the erroneous conclusion in economic geography that all mathematical modeling is necessarily based upon equilibrium theorizing that is grounded in methodological individualism. Nothing could be further from the truth. In contemporary economic geography, there exists an alternative way of playing the game of mathematical modeling: regional political economy (Plummer et al., 1998). According to this approach, the capitalist space economy should be conceived of as evolving out of equilibrium, as a complex and conflict ridden spatio-temporal system. Employing assumptions derived from classical and Marxian political economy, regional political economists have constructed mathematical models to account for differential urban, regional, and national growth (Sheppard and Barnes, 1990; Webber and Rigby, 1996), the dynamics of regional capital and labor markets (Webber 1987a; Clark et al., 1986), and the location and pricing strategies of firms (Plummer, 1996).

According to this alternative vision of the economy, the evolving economic landscape consists of sets of heterogeneous and interdependent agents, making decisions out of equilibrium and under conditions of economic uncertainty. In contrast to the rationality postulate of neoclassical economics, agents are assumed to possess limited information and computational ability. In addition, their participation in the economic system is conditioned by membership of one or more economic classes. Similarly, space is conceptualized both as heterogeneous and as endogenously created as a result of changes in transport technology and the location of production and consumption (Sheppard, 1990a). The way in which economic agents adjust their strategies and decision rules depends on how those agents are embedded in evolving social and geographical structures. In turn, the evolution of the spatial economy depends on how these agents behave within a given context (Sheppard, 1990b). That is, agents construct, but are also embedded in, society and space.

A model design based upon these alternative assumptions about the nature of social and geographical reality has two broad implications for the ways in which we understand the evolving economic landscape. First, the neoclassical vision of capitalism as an economic system that promotes the rational, harmonious, and equitable distribution of resources in society no longer holds. Rather, the distribution of resources amongst members of society depends, in part, on the social and political power of members of economic classes. Furthermore, there exist no equilibria that simultaneously maximize the interests of all economic actors. More generally, individual decisions can result in unintended consequences that oppose the interests of other classes, and those of other members of the same class (Sheppard and Barnes, 1986). This undermines the neoclassical notion that capitalism promotes the rational and equitable distribution of resources in society.

Second, the evolving economic landscape is understood as a fundamentally non-equilibrium system, subject to both equilibrating and disequilibrating forces (Webber and Rigby, 1999; Plummer, 1999). Whilst the existence of an equilibrium configuration of prices, outputs, and profits can be shown to exist in theory, the dynamics of spatial competition are such that this equilibrium is only "weakly" stable, and easily destabilized. In turn, if geographical reality does not approximate an equilibrium configuration, then this undermines the methodological justification for searching for predictable relationships between observed patterns. Rather, the orientation of mathematical modeling shifts from a concern with describing and explaining spatial patterns to a concern for the dynamics that drive the spatio-temporal trajectories of capitalist economies. By now, the message should be clear. A modeling approach does not presuppose that our model design should be based upon a particular set of assumptions about the way in which society and space are organized. However, the ways in which both society and space enter our model design are critical to the properties that can be deduced from our mathematical models.

Modeling in the Contemporary Context

It is now commonplace to accept a dualism between an analytical and a contextual approach to understanding the evolving economic landscape. The analytical approach tends to be characterized by quantitative reasoning and a search for spatial patterns that is, at best, grounded in mathematical models derived from neoclassical economics. For many contemporary economic geographers, this form of modeling is too constraining to capture the complexity of actually evolving economies. In place of mathematical models, it is considered more profitable to employ discursive models and qualitative reasoning in an attempt to understand the complexity and contingency of societal processes. In this chapter, I have argued that proclamations about the death of mathematical modeling are premature. To justify my claim, I have attempted to demonstrate that it is possible to engage in mathematical modeling without recourse to either a positivist vision of geographical ways of knowing, or a social ontology that is grounded in neoclassical economics.

Within the contemporary context, if the modeling approach is to provide a plausible framework for explaining the evolution of the economic landscape, then we need to move beyond traditional location theory. This will entail a shift in the orientation of mathematical modeling away from the search for spatial patterns and equilibrium-oriented theoretical models towards a modeling approach that reflects the complex dynamics that operate on and through the economic landscape. If the space economy is viewed as a complex construction of nonlinearly related societal processes, then this has profound implications for what we can expect models to tell us about the social world. The goal of taking seriously the spatial and temporal aspects of capitalist economies may well challenge the limits of what may be possible with mathematical models. In this regard, however, the modeling approach is no different from any other approach to economic geography. Whether we are employing "quantitative" or "qualitative" research methodologies, we all face limitations and possibilities. The challenges of research are to confront the limitations of our approach and to explore the possibilities.

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