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UNION OF ECONOMICS WITH GEOGRAPHY BASED ON THE CONCEPT OF LOCATION: A HISTORICAL PERSPECTIVE

Ayşen Hiç Gencer*

ABSTRACT

This paper lays down the path from the period of the European Renaissance until the present time of how economists and geographers finally came together in their pursuit of explaining economic phenomenon taking into account geographical features based on the concept of location.

Underlying this path is the fact that social sciences cannot be taken one by one and independently from each other: One cannot separate economics, political science, political economy, anthropology, sociology, psychology and arts from geography and history. Moreover, physics, chemistry, biology, astronomy as well as mathematics and statistics also interact with this big picture. It is due to this synthesis aspect that today as a result, following Paul Krugman, the New Economic Geography emerged as an hybrid field.

Key Words: *Economic geography, Location, Spatial economics, Quantitative revolution and model building, İnternational trade, Transportation, Regional science, Urbanization, Agglomeration.*

İKTİSAT İLE COĞRAFYA BİLİMLERİNİN MEKAN KAVRAMI ÜZERİNDEN BİRLEŞMELERİ: TARİHSEL BİR YAKLAŞIM

ÖZET

Bu makale, Avrupa'da Rönesans döneminden günümüze değin geçen süre içinde, ekonomistler ve coğrafya bilimcilerinin nihayet nasıl bir yol izleyip biraraya gelerek ekonomik olayları mekân kavramı üzerinden coğrafi özelliklere dayandırarak belirlemeye başladığını analiz etmektedir.

Bu birleşmenin altında yatan gerçek, sosyal bilim dallarının aslında hiçbir zaman tek tek ve biribirlerinden bağımsız olarak ele alınamayacaklarıdır: Ekonomi,

* Y. Doç Dr. Ayşen Hiç Gencer, Beykent Üniversitesi, İktisadi ve İdari Bilimler Fakültesi, Ekonomi Bölümü

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siyaset bilimi, siyasi ekonomi, antropoloji, sosyoloji, psikoloji ve sanat , esasen coğrafya ve tarih bilimlerinden ayrılamazlar. Ayrıca, fizik, kimya, biyoloji, astronomi, hatta matematik ve istatistik dahi bu büyük çerçevede yer almaktadırlar. Sonuçta bugün, sosyal bilimlerdeki bu sentez açısı dolayısıyla, Paul Krugman'ı izleyerek Yeni Ekonomik Coğrafya bilimi ortaya çıkmıştır.

Anahtar Kelimeler: *İktisadi coğrafya, Yer / mekân, Mekânsal iktisat, Sayısal devrim ve model kurma, Uluslararası ticaret, Nakliyat, Yöresel bilim, Kentleşme, Kümelenme.*

1. INTRODUCTION

It is obvious that economic activity in the world is not distributed evenly. In fact, most activity, especially economic, happens in agglomerated regions. The scale of agglomeration can be small, as in many apparel shops clustering in a mall; or it might be worldwide, like the Silicon Valley. Therefore, economic geography, that is the study of where economic activity takes place and why at that particular place, should be an interesting and important subject to study for economists.

In examining systems of society the geographer shares a common interest with other academic disciplines, particularly economics, but he/she has a distinct view point: The essence of the geographical approach is that it is *spatial*. It is fundamentally concerned with the ways in which economic activities are arranged on the surface of earth and with the processes that lead to such spatial patterns.

Economists have increasingly branched out into new fields by using the methods of economics to address the research problems of other disciplines. To give some important examples, one may think of the work of Gary Becker and James **C**oleman in economic sociology, Anthony **D**owns in political science, or the impact of the new institutional economics on law studies. This has frequently resulted in a fruitful exchange of research problems, ideas, and methods.

However, until recently, much of mainstream economics ignored economic geography. This should not necessarily be taken as a lack of interest or ignorance. The main reason economists did not work on this topic is because they regarded it as intractable and could not formally model imperfect competition. Although regional scientists and urban economists have both provided suggestions, their agglomeration effects and externalities

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were ad hoc, and their models were loose and sloppy. However, as new tools, in particular, models for industrial organization, international trade, and endogenous economic growth were developed, technical barriers that kept economists away from this field have been removed.

2. CONCEPTS OF THE PHENOMENOLOGY OF SPACE AND PLACE: PAST AND PRESENT

2.1 Ideas of Space and Place in the Period of the European Renaissance

Jean Bodin (1576), one of the most important thinkers of the Renaissance with respect to history, contemporary life and geographic environment, lived during the years of great religious wars (1560s and 1570s). Bodin divides the northern hemisphere into three latitudinal zones of 30 degrees each and calls them "hot", "temperate" and "cold" zones. He thinks that the temperate zone is the most habitable one excepting those parts of it in rugged highlands, swamps and arid or sterile lands. He further divides the temperate zone into two at the 45th parallel and calls them "north" and "south".

His main idea is that the climate affects people's character, their mental and physical qualities. The people of the south are a contemplative sort, adept in the secret sciences, the black bile or melancholy dominant among them, causing prolonged meditation. They have the ablest philosophers, mathematicians and prophets. The people of the north are skilled in activities that depend on the senses, they know well the manual crafts and the arts, and they have mechanical skills.

Bodin is concerned with the degree of environmental control over man. He does not believe that climate is the only influence. The fusion of people changes the customs and the nature of man quite a bit. Fusion and blending are common in the temperate zones because people from the extreme zones have moved there because it has the most equable climate. He appreciates the role of war, migration, cultural contact in molding the life and customs of people, but he does not apply the idea on a larger scale to show that the history of migration and the diffusion on the physical and mental traits by any means may be more fundamental explanations than climate in understanding human history.

Bodin's main point is that the human character depends, either

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directly or indirectly, on climate. Even the people who migrate affect the human character in their destinations consistent with the human character in their origins.

Giovanni Botero (1589), a Jesuit-trained scholar writing during the counter-reformation in 1580s, also talks about the division of the earth, however, not only in terms of north-south but also east-west. He also distinguishes different characters of people living in different climates, e.g. maritime lands (alert, sagacious, prosperous) versus interior (sincere, loyal, easily contended). He then discusses the importance of man in shaping their spatial environment. He advocates a large population but emphasizes the benefit to a country of having a dense one as well, because dense populations attract money through trade and commerce from all parts of the world. "Where there are many people, the land must be well cultivated and the land provides the foodstuffs necessary for life, and the raw materials for the industry."

Botero thinks that to make a state great and populous, the industry of man is definitely more important than the fertility of the soil. First of all, the products of the manual skill of man are more in number and of greater worth than the produce of nature because nature provides the material and the object but the infinite variations of form are the result of the ingenuity and skill of men.

From Botero's arguments it is evident that he believes that nature is created for man to shape it and fit it to his use. In his view, God created water not only because it was a necessary element for the perfection of nature, but more than so, as a means to bring goods from one country to another.

George Hakewill (1627), in his "Apologie", is concerned with the "decay of nature". In his time the general belief was that the natural disasters were increasing in frequency and in violence. Almost any natural phenomenon was regarded as an evidence of decay: air pollution, storminess, weather changes, earthquakes, volcanoes. He argues, however, they have occurred in all periods of world history, maybe even more severe in ancient times.

To the argument that the land is being gradually inundated by the sea, another indication of decay, he replies that the areas taken up by all kinds of waters had always been the same in the past and present. What is lost in one place is recovered in another. Lands also maybe born and wasted with tillage and need time and rest to recover. Again, in the cycle of erosion nothing is

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lost. The earth is the scene of great transports of soil from one place to another, in the wearing down of mountains and in the building of delta plains.

Hakewill's main point is that nature has a system on its own and man cannot change or affect it. The earth is the same, its dimensions are the same, its fertility is the same. The balance is always maintained.

John Ray (1691), a natural theologist who published in 1690s, makes a cogent synthesis, including environmental changes by man within his psycho-theology. His synthesis includes elements such as heavy reliance on teleological explanations of processes in nature, emphasis on the beauty and usefulness of the nature, a vision of man as actively changing nature under the guidance of God, and the conviction that changes made by man become part of a harmony thus newly created.

According to Ray, mankind clearly plays an active role in nature, and man advances by increasing his knowledge of the ways he ca use earth's resources. God designed the earth providing an abundance for the use of man, who, God knows beforehand, has the necessary reason and understanding to adapt its offering (while he is adapting himself to it) by means of discovery and invention to his own uses.

Ray's main point is that man shapes the nature for his own use. However, man's changes to the nature become a part the nature and this process continues.

2.2 Modern Theories of Space and Place

The pioneers of modern theories are Henry Lefebvre and Yi-Fu Tuan both of whom published mainly in the 1970s. They both talk about space and place but in entirely different ways, since their goals are different. Lefebvre, a sociologist and geographer, has a social perspective and is very concerned with objectivity. Tuan, on the other hand, is a humanistic geographer and is purely subjective.

Henri Lefebvre (1991), in his book "**P**roduction of **S**pace", thinks about space as an abstract concept. He is not contended only with the strictly geometrical meaning of space, as it is used in pre-modern ages. Lefebvre builds a unitary theory of space which is concerned with three fields of space:

- The physical space: The nature and the cosmos
- The mental space: Logical and formal abstractions

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• The social space: Position (status) in society

Lefebvre is concerned with the production of social space where he takes the concept of production to have a more abstract meaning extending beyond philosophy. Every social space is the outcome of a process with many aspects and many contributing currents, signifying and non-signifying, perceived and directly experienced, practical and theoretical. In short, every social space has a history which is invariably grounded in nature. This history is to be distinguished from an inventory of things in the space, and also from ideas and discourse about the space.

Yi-Fu Tuan (1976, 1977) isn't satisfied with the singular spatial focus of geography of 1970s, which led him to an interest in articulating an alternative to it in the form of a concept of place. Tuan sees place as combining the sense of position within society with the sense of and identity with spatial location that comes from living in and associating with it. Place can be as small as the corner of a room or as large as the earth itself. The place of a crawling child is under the piano, but the earth is, especially for a homesick astronaut, our place in the universe.

Place means primarily two things that overlap to a large degree: one's position (status) in society, which is under the scope of sociology, and spatial location, which is under the scope of geography. Spatial location derives from position in society, rather than vice versa. "The infant's place is the crib, the child's place is the playroom; myself and chairman of the board sit at different places at the dinner table." People are defined first by their positions in society, their characteristic lifestyles follow.

Tuan thinks that places distinguish themselves from locations or functional nodes by means of two characteristics:

- Spirit and personality: Space is formless and profane except for the sites that stand out. Personality suggests the unique: places, like human beings, acquire unique signatures in the course of time. The personality of a place is composite of natural endowment (the physique at hand) and the modifications wrought by successive generations of human beings.
- Sense: Places may have spirit or personality, but only humans can have a sense of a place. This can mean two things. One is visual or aesthetic. Places are locations that have a visual impact. The other concerns all the other senses: hearing, smell taste and touch. These senses, unlike the visual, require close contact and long association with the environment.

The most important distinction Tuan makes is between two types of places: *Public symbols* are places that yield their meaning to the eye. *Fields*

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of care are places that are known only after prolonged experience. Public symbols speak to the visual senses, whereas field of care do not seek to project an image to outsiders. Public symbols include monuments, public squares, public buildings. Fields of care include marketplaces, street corners, homes.

Tuan makes the following main distinction between space and place: Place is security, space is freedom. From the security and stability of place we are aware of the openness, freedom and threat of space and vice versa. In practice, the meaning of space often merges with that of place. Space is more abstract than place. What begins as undifferentiated space becomes place as we get to know it better and endow it with value.

2.3 Comparison of the Concepts of Space and Place: Past and Present

It is evident that theories of the Renaissance era are more concerned with nature and human being's relationship to nature, whereas modern theories deal with space on a more abstract scale. In Renaissance theories the debate is whether humans shape the nature or whether the nature shapes humans. Although Bodin and Hakewill have a more neutral view on the relationship between humans and nature, Ray and Botero think that God created nature for humans to shape it according to their needs and benefit from it. The abstract aspects of the concepts of space and place is not well developed yet, all thinkers are concerned with the physical space, the nature.

Modern era thinkers Lefebvre and Tuan, on the other hand, view space and place as concepts that have a meaning beyond their physical implications. Lefebvre talks about mental and social spaces, whereas Tuan attaches personality, spirit and sense to places. Both of them are concerned with the creation of space and place, although in a much different sense than Renaissance thinkers. They view the evolution of a location from a physical to a social entity as the foundation of creation of space and place.

In the Renaissance era, where the technology level was behind the modern era, the main ideology is conquering the nature and survival instincts. Therefore, Renaissance thinkers are mostly concerned with humans commanding the space they are in. In modern times, however, technology helped people to live comfortably, assuring that survival was given. Thus, modern thinkers are mostly concerned how humans bring meaning and character to a space. They transform space in such a way that they get a

sense of owning and belonging to that space. These concepts fit very well with environmentalism that became dominant in late 20th century.

The thinking of "perfecting nature for man's use" in the Renaissance era brought advances in geography that are directly related to understanding and predicting the nature: Drawing maps, understanding climates, analyzing soil and waters, predicting weather, astronomy, etc. The thinking of "social creation of space" of the modern times brought advances in geography that are directly related to owning and protecting space: Environmental concerns, preserving clean air and water, ideas such as "We didn't inherit the world from our parents, but we borrowed it from our children.", shift of focus in transportation from creating transportation systems (at the expense of destroying the character of space) to better managing existing ones or reverting previously done damage (Big Dig of Boston). Aesthetics rather than functionality comes to foreground.

2.4 Conclusive Remark

Underlying all of these, it is clear to see that social sciences cannot be taken one by one and independently from each other: One cannot separate economics, political science, political economy, anthropology, sociology, psychology and arts from geography and history. Moreover, physics, chemistry, biology, astronomy as well as mathematics and statistics also interact with this big picture.

It is this synthesis aspect that makes geography a unique science. The following section dwells on this remark in detail.

3. SPATIAL SCIENCE

The geographer is identified not so much by what he studies as by how he studies it. In examining systems of society the geographer shares a common interest with other academic disciplines, particularly economics, but he/she has a distinct viewpoint: The essence of the geographical approach is that it is *spatial*. It is fundamentally concerned with the ways in which economic activities are arranged on the surface of earth and with the processes that lead to such spatial patterns.

It would be misleading to suggest that all economic geographers possess a single unitary viewpoint. Not only has the nature of economic

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geography (as of: geography as a whole) changed over time, but also at any one point in time there are differences between economic geographers in their philosophical and methodological approaches. But throughout the development of: this field, from mid-nineteenth century to the second-half of: the twentieth century it has been possible to identify a central concern, namely, that of: space.

3.1 Regional Science

The term *space* has become widely used only in the last two decades. Earlier generations have used such terms as area, region, place, landscape – which, although not exactly synonymous with space, are particular facets of: it. It is worthwhile to note that the current spatial viewpoint differs considerably from its predecessors: Economic geography in its infancy was concerned with compiling mountains of: factual information about economic activities in different parts of: the world, just as geography as a whole accumulated facts about the earth's surface in general (regional science).

Richard Hartshorne (1939), in "The Nature of: Geography" is concerned with the question what the purpose of: geography is. Should geography seek to formulate scientific laws or should it serve to describe individual cases. Hartshorne believes that the latter should be the case. This led to the birth of: regional geography. Between 1930s and 1950s, the primary focus of: geographical concern was what Hartshorne calls areal differentiation: Differences rather than similarities between places. Hartshorne is not concerned with time and therefore he does not worry about the process of: regionalization. His aim is to describe a snapshot of: regional differences.

Today, however, there has been a major shift of: emphasis away from the particular question of: *how* economic phenomena are located to the question of: *why* such phenomena are located as they are. Modern spatial scientists are not simply interested in spatial patterns, they are more concerned with the processes that produce such patterns.

3.2 Quantitative Revolution

In late 1950s and early 1960s, with the effects of: positivism many geographers felt that the descriptive framework of: regional science was not sufficient and lacked a coherent covering theory. There were movements of:

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social physics which tried to apply physics type models to examine human spatial behavior. The gravity model is the most important example. Major contributors to this approach are Walter Isard at Cornell University; Waldo Tobler, Richard L. Morrill, Arthur Getis and Judith Getis at University of Washington; Tuafe, Ted W. Gastier, T.R. Lakshmanan and Morton O'Kelly from Ohio State University; and B.J.L. Berry from University of Chicago. This movement later carried on to Europe, especially to the U.K. with Peter Haggett.

With the quantitative revolution and emergence of spatial science, the *formal* region paradigm of the Hartshorne framework shifted into *functional* region paradigm. Whereas a formal region is characterized by its internal properties, a functional region is characterized by its interactions with other regions. The idea of functional region also became the central concept in physical geography.

Haggett (1977) incorporated forms of representative quantitative and dynamic analysis and become more dependent on statistics and econometric theory. During the same period multivariate methods were developed by econometricians, but none of them incorporated space. There was no methodology that was explicitly spatial. A.D. Cliff and J.K. Ord (1972) criticized much of this and tried to incorporate spatial dependence with spatial auto-correlation. Ultimately, all of these led to modeling.

3.3 Model Building

The most important way in which modern spatial science differs from its predecessors is in its concern with theory and use of models. Model building is just representing a complex situation in a more simplified form. In model building scientists try to reproduce the most important attributes of a situation under controlled conditions. However, for a social scientist, unlike a physicist, this task is not so simple since he cannot control human actions. Instead, he has to imagine what would happen if certain conditions were fulfilled. In other words, he has to make some simplifying assumptions.

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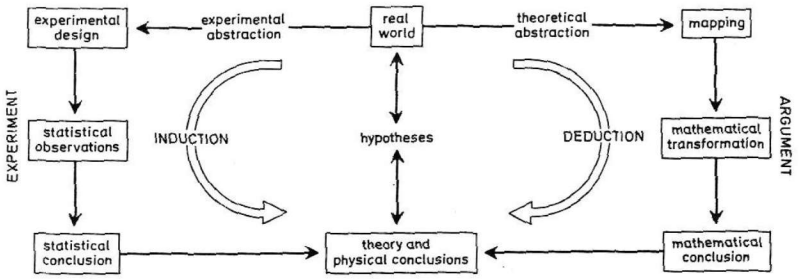

Figure 1: Methods of modeling

Models which begin from a set of assumptions and develop predictions about behavior are known as *deductive* models. As depicted on the right-hand-side of Figure 1 deductive models depend on the development of a priori assumptions that are not inducible or perceived. Examples to this category are: Johann Heinrich von Thünen (1826) model of agricultural location, Alfred Weber (1909) model of industrial location, and Walter Christaller's (1933) and August Lösch's (1954) central place theory.

Models which are built up from observation and from generalizations about them are called *inductive* models. The left-hand-side of Figure 1 shows the inductive route to theory formation where experimental design draws from theory and leads to statistical conclusions and hence, to the development of further theory. A prominent example of this approach is the gravity model.

The quantitative revolution in geography and associated fields of planning led by spatial scientists had a major impact on the way the disciplines developed. Both strands of spatial science, inductive and deductive, contributed to this change. However, even after twenty-five years since the revolution started there is considerable criticism of the approach, especially from the practitioners of the deductive paradigm. These two paradigms are not really distinct anyway. Ultimately, whatever theoretical basis adopted, statistical and mathematical tools will be helpful in developing some aspects of the theory. Indeed, now that both inductive and deductive approaches are fully absorbed into spatial science, the debates have shifted to understanding their benefits and limitations.

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3.3.1 Von Thünen Model of Agricultural Land Rent and Agricultural Land Use

Late nineteenth century economist von Thünen envisioned an agricultural plane supplying a variety of products to an isolated central city. In his theory the land rent declines from the center to the outer limit and a series of rings in which different crops would be cultivated form. Thus, the high rent land near the center would be reserved for crops with high cost of transportation and/or crops yielding high value per acre. The outer most ring would consist of either land intensive or cheaply transported crops.

The most important feature of the von Thünen model is that it predicts spatial patterns starting from economic assumptions. However, the model lacks an important aspect of spatial science: It does not attempt to explain why the central city was there in the first place. Even with that limitation the model is regarded as one of the cornerstone works in spatial science.

3.3.2 Weberian Location Theory

Weber analyzed the location decision of a firm serving one or more markets and relying on one or more suppliers. Major contributors to this theory were Isard, Moses, and Miller and Jensen, who expanded the model by relaxing some of the assumptions made by Weber. However, all that the Weberian location theory does is to minimize transportation costs. It does not answer questions such as why must there be only one productions site, that is, are the economies of scale so large that this is the only optimal solution.

3.3.3 Central Place Theory

Central place theory analyzes the location and roles of manufacturing, marketing, etc. centers serving a hypothetical, evenly spread agricultural population. In this tradition, Lösch had the geometric insight (that the market areas should be hexagonal), while Christaller produced the idea that there should be a hierarchy of central places with nested market places.

Central place theory, unlike the previous theories, also considers economies of scale and tries to find a trade-off between economical scale and transportation costs. However, since all of the work done on this model is published in German, it did not have many followers until recently.

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3.3.4 Gravity Model

Unlike the previous models, the gravity model is actually a purely empirical model. The model resembles the law of gravity in physics which says the attraction between two objects is proportional to their masses, but inversely proportional to the distance between them. Likewise, in the gravity model, the volume of transaction between two cities - measured in number of trips, or value of goods shipped – is proportional to their sizes – measured as their population or purchasing power – but inversely proportional to the distance between them.

This model works extremely well in many applications, both in spatial economics and in international trade. However, it obviously lacks microeconomic foundations and therefore has been a big target of criticism.

Followers of this model, including T.R. Lakshmanan, have extended it to include constraints on production and/or attraction sides.

3.4 Spatial Science and Philosophical Frameworks

One difficulty for the non-geographer observing activities within the field is to decide whether geography is a science or a humanity. Within geography itself the science/non-science question is seen less important than the question of what kind of a science geography is. Newton's demonstration of laws of gravitation let scientists believe that it was conceptually possible to forecast the fate of every atom in the universe both forwards and backwards through time. In geography this optimism had its expression in the ideas of *environmental determinism*, in which human behavior was seen to be predictable in terms of the physical environment.

However, the discovery of Werner Heisenberg's uncertainty principle led to the collapse of such ideas both in physics and in geography. Instead, probabilistic trends allowed a new view of human behavior in which both free-will and determinacy could be accommodated. According to Jacob Bronowski (1960) this could be simply a scale issue: "A society moves like a gas under pressure. On the average, its individuals obey the pressure, but at any instance any individual may, like an atom of gas, be moving in any direction." Clearly, the gravity model agrees well with this approach.

Spatial science is mainly a positivist approach. *Positivism* is a philosophical approach which holds that our sensory experiences are the

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exclusive source of valid information about the world. A positivistic approach leads to the discussion of human behavior in terms of analogies drawn from the natural sciences, gravity model being the obvious example. In spatial science as in all positivist frameworks measurement, modeling, processes (in this case, spatial processes), and integrated systems play a central role.

Given the disciplines evolution story, it's normal that positivism played a major part. Lately, interest in a phenomenological approach in geography was renewed. *Phenomenology* is an existential philosophical approach that admits that introspective or intuitive attempts to gain knowledge are valid. Although much of spatial science use a positivist approach, some work, like the von Thünen model, have phenomenological aspects.

3.5 Relationship of Spatial Science to Other Disciplines in Geography

The relationship of spatial science with other disciplines in geography can be best understood by examining Figure 2. As one can readily see, spatial organization is at the heart of the Figure and shares links to the following disciplines:

- Economic geography which leads to economics and location theory.
- Quantitative methods which leads to statistics, probability and econometrics.
- Political geography which leads to regional studies.
- Field methods which leads to cartography and remote sensing.

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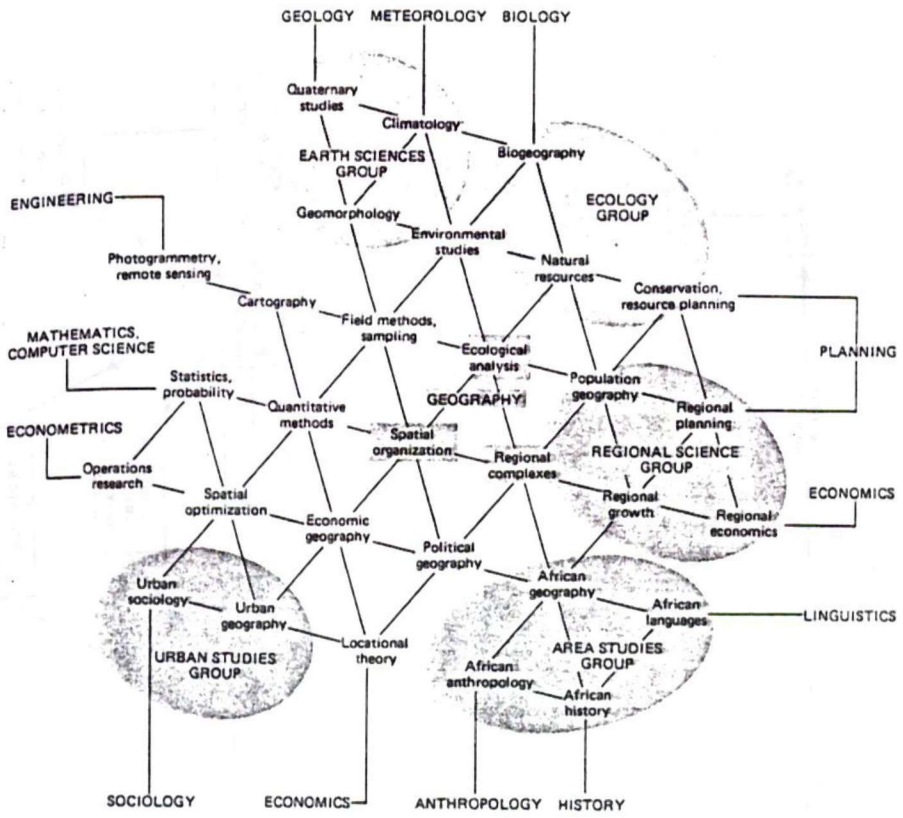

Figure 2: Relationship of spatial science to other disciplines

3.6 Remote Sensing and Geographical Information Systems

Spatial science, quantitative geography and modeling required large amounts of geographical data to be collected and efficiently stored. This lead to the development of remote sensing in 1970s and geographical information systems in 1980s for data collection and storage purposes, respectively.

As we discussed, spatial science is dedicated to the analysis of spatial order and associations of a variable. Therefore, a prerequisite of spatial science is that the studied variables are mappable. Maps provide an effective two-dimensional representation of spatial distribution because the human eye is extremely adapt at detecting spatial patterns. As long as a need to

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divide and allocate space existed maps have been used as the primary instrument for the detection or imposition of spatial order.

Remote sensing as a way of map making has been used as early as during the **U**S civil war. Whereas early approaches were limited to areal photography, with the advance of satellites and electronic imaging equipment, remote sensing became the primary source of spatial data collection of any kind.

Maps alone, however, are often not sufficient for analysis in spatial science. Even though it is possible with the help of remote sensing to generate maps of many data types, certain relationships may be obscured or hidden in maps. Moreover, a map representation is not suited as a data input to an econometric model.

This led to the development of geographic information systems (**GIS**). **A GIS** combines technologies of data base management systems with automated cartography and allows for map features to be geographically referenced with logically connected spatial data and map features. **C**onsequently, entities related to the study phenomenon can be manipulated easily.

The most important contribution that the new **GIS** technology has brought to spatial science is the establishment of a link between map-based analysis of spatial patterns and well developed, rigorous quantitative analytical methods. With appropriate measurements of map features, interpretation of spatial patterns is no longer subjective. Because spatial models can be objectively assessed, hypothesis can be formulated and verified.

4. ECONOMIC GEOGRAPHY AS A SCIENTIFIC PURSUIT

4.1 **Economic Geography** as Spatial Science

During the Second World War, geography started shifting away from regional geography, which is primarily concerned with unique characteristics of regions. **A**ccording to **H**artshorne (1939), one of regional geography's most prominent names, "no universals need to be evolved, other than the general law of geography that all areas are unique". Thus, prior to Second World War, geography was mostly a descriptive science, with the goal of "knowing the character of regions and places through comprehension of

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their existence and interrelations among them".

During and after Second World War, a new field called *Systematic Geography* emerged, which is concerned with practical notions about transportation and industrial location. Lack of modern scientific methodologies and the remoteness of the discipline from practical and social utility was recognized by a group of scientists calling themselves "Social Physicists", who argued that "the principle of least effort" governed human behavior as much as laws of physics governs nature. J.Q. Stewart (1948) told that there is no longer any excuse for ignoring the fact that human beings obey mathematical rules resembling the laws of physics.

Geography as the study of regional uniqueness could never use the methods of physics, which depend fundamentally on the recognition of regularities. For geography to be a modern science it had to be redefined away from the irregular and towards the study of space as regularity, that is, space had to be re-conceptualized not as the irregular characteristics of natural environments, but as pure, simple and quantifiable. A geography truly modern in the sense of modern mathematical science dedicated to the pursuit of truth required a spatial unification as opposed to an areal differentiation.

As discussed in the previous section, followers are von Thünen, who studied the distribution of agricultural land use around cities; Weber, who studied the distribution of industrial centers (the location theory); and Christaller, who studied the regular distribution of central places in Southern Germany and idealized that distribution as hexagonal, hierarchical structures (the central place theory).

In late 1940s and early 1950s, Walter Isard (1956) developed the notion of S*patial Economy* and used tools from economics, such as mathematical models and graph synthesis. He and his followers dealt mainly with the location of economic activities in space based on the principle of least effort expressed as distance minimization in trips to service centers. This brought a big shift in geography as a science.

In 1963, Ian Burton noted that "In the past decade, geography has undergone a radical transformation of spirit and purpose, best described as the Quantitative Revolution. The consequences of this revolution have yet to be worked out and are likely to involve the mathematization of much of our discipline, with an emphasis on the construction and testing of theoretical models." According to Burton, a social science needs to acquire demonstrable value as a predictive science. The quantitative revolution was

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thus inspired by a genuine need to make geography more scientific, nomothetic (law stating) instead of ideographic (descriptive). The core of scientific method, he said, is organizing facts into theories which are tested or validated through prediction of the unknown.

4.2 Scientific Method

Thomas Samuel Kuhn (1962), in "The Structure of Scientific Revolutions", argues that the pattern of natural scientific development reveals a picture of scientific inquiry different from the version of strict methodological rules propounded by the descendants of positivism. According to Kuhn, science appears to develop in a linear cumulative fashion.

Kuhn defines paradigms as achievements that share two characteristics: it should be sufficiently unprecedented to attract an enduring group of followers away from competing modes of scientific activity and it should be sufficiently open-ended to leave all sorts of problems for the followers to resolve. Usually, normal research problems are not geared to produce major novelties, but rather to articulate the paradigm from which it is derived. To scientists the results gained in normal research are significant because they add to the scope and precision with which the paradigm can be applied.

Kuhn says that accepted paradigms are disrupted by revolutionary periods in scientists puzzle-solving activities. These activities usually find their roots in rare, unexpected phenomenological observations obtained during normal research.

Carl Gustav Hempel (1967), in "Aspects of Scientific Explanation", tries to correlate empirical statements, experimental findings and predictions. According to Hempel, an empirical statement is testable if it is possible to have experimental findings which would confirm or dis-confirm it. Here, the concepts of confirmation and dis-confirmation of an empirical statement should not be mixed up with conclusive verification and falsification of a theoretical statement which does not require any experimental data.

To illustrate the difference between absolute verification and falsification and confirmation and dis-confirmation Hempel use examples form statistics. For example, if Jones is a Texan and if 99% of Texans are millionaires, then Jones is almost certainly a millionaire. On the other hand, if Jones is also a philosopher and if only 1% of philosophers are millionaires,

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then Jones is almost certainly not a millionaire. Although each statement about Jones can confirm or dis-confirm the statement about him being a millionaire, neither of them can conclusively verify or falsify it. Similarly, there is a conceptual difference between "all of the n examined instances of A satisfy the statement B" and "A satisfies the statement B".

According to Hempel, general hypotheses in science as well as in everyday use are intended to enable us to anticipate future events; hence, it is reasonable to count any prediction that is borne out by subsequent observation as confirming evidence for the hypothesis on which it is based, and any prediction that fails as dis-confirming evidence. In short, predictions are deduced statements about future events and are therefore symmetrical with explanations.

While deductive explanation is integral to all empirical science, social scientific theory and history differ from natural science in that their laws are often derived from common sense while their empirical basis cannot be stated with precision. Moreover, it is very difficult to obtain laws in the social sciences that are absolutely verifiable or falsifiable. In Ernest Nagel's version of this proposition, most generalizations in social sciences are statistical uniformities (i.e. regularities) rather than universal laws. Likewise, Hempel sees functional analysis in social sciences explaining patterned, repetitive forms of social behavior in relation to larger social systems. For both Hempel and Nagel, interpretative understanding can only suggest hypotheses which have to be established in deductive form and tested empirically to become scientific hypotheses.

4.3 Relationship between Maps and Fieldwork

Peter Haggett (1989), in "The Geographer's Art", talks about the importance of maps in geography. He cites Hartshorne: "So important is the use of maps in geographic work that it seems fair to suggest to the geographer a ready rule of thumb to test the geographic quality of any study he is mapping: If the problem cannot be studied fundamentally by maps, then it is questionable whether or not it is within the field of geography.''

According to Haggett, if the boundaries of academic disciplines are regarded as markers of limits of focused concern and competence, then maps must be a distinctively geographic feature. The reason being twofold: First, map play a distinctly central role in geography than in other disciplines. No other field insists that students should take courses on map-making and map-

reading. Second, other disciplines turn to geographers for the production of maps, for collection and care of maps, and for interpretation and analysis of maps.

Geography is a science of a macroscopic scale with relevant sizes ranging from 100 meters to size of the earth. Unlike microscopic sciences where small features have to be brought up by magnification to a scale where our eyes and minds can understand them, in geography we need to shrink very large features to make them comprehensible. Moreover, for the most part, earth's surface (which is the main concern of geography) can be considered as a two dimensional plane, thus a map is a very practical way of understanding it – unlike astronomy where three dimensional interactions are important.

Traditionally, maps were related directly to space: The distance between any two points on the map is proportional to the actual spatial distance between them. On this proportional map major characteristics of the area such as rivers, cities, etc. can be plotted. Also a contour plot may be superimposed on this map. The contours may represent any quantity such as the elevation, population density, vegetation, etc. However, with the advent of computers non-linear mapping became possible. In a non-linear map, the distance between two points on the map is proportional to some other quantity than the spatial distance, e.g. time of travel or cost of travel between those two points.

Basically, maps help us to visualize some data that has been collected in an exploration or fieldwork. Because geographers cannot bring the whole world back into their laboratories, they traditionally went out to conduct fieldwork in small areas. This created the problem of linking their own local fieldwork and the standard regional data. There, again, they resort to maps.

While performing fieldwork, it is easier to collect data for local quantities which are mostly physical: At any given point the elevation can be determined, or vegetation can be recorded. The problem becomes more complicated for human geography. First of all, most of the data used in human geography cannot be measured at any given point, but is released for administrative areas (e.g. population, population density, etc.) Secondly, these administrative areas vary widely in shape between countries and even within countries. Moreover, the data collection procedures are different as well.

As one can observe, maps serve two main purposes in geography: One being bringing the area of interest to a comprehensible scale, the other being

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bringing the collected field data to an analyzable form.

4.4 Mainstream Economics and Economic Geography

It is obvious that economic activity in the world is not distributed evenly. In fact, most activity, especially economic, happens in agglomerated regions. The scale of agglomeration can be small, as in many apparel shops clustering in a mall; or it might be worldwide, like the Silicon Valley. Moreover, urban places follow a strict hierarchy as described by the central place theory.

Therefore, economic geography, that is the study of where economic activity takes place and why at that particular place, should be an interesting and important subject to study for economists. Economists have increasingly branched out into new fields by using the methods of economics to address the research problems of other disciplines. To give some important examples, one may think of the work of Gary Becker and James Coleman in economic sociology, Anthony Downs in political science, or the impact of the new institutional economics on law studies. This has frequently resulted in a fruitful exchange of research problems, ideas, and methods.

However, until recently, much of mainstream economics ignored economic geography. This should not necessarily be taken as a lack of interest or ignorance. The main reason economists did not work on this topic is because they regarded it as intractable and could not formally model imperfect competition. Although regional scientists and urban economists have both provided suggestions, their agglomeration effects and externalities were ad hoc, and their models were loose and sloppy. However, as new tools, in particular, models for industrial organization, international trade, and endogenous economic growth were developed, technical barriers that kept economists away from this field have been removed.

4.5 New Economic Geography

Since late1970s the field of *New Economic Geography* emerged. The catalyst was the development of tractable models of competition in the presence of increasing returns to scale. In particular, Dixit and Stiglitz (1977) developed a formalization of Chamberlin's (1933) concept of monopolistic competition that laid the foundation for this field.

A number of theorists applied the analytical tools of the new industrial

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organization theory to international trade; and a few years later the same tools were applied to economic growth. In each case new concepts needed to be developed and debates over models had to be made. The new economic geography is at a similar stage right now.

The cornerstone paper of this field was Paul Krugman's 1991 seminal paper. This was followed by a number of papers by Krugman, Fujita, Venables and Puga. All of this work was put into a single perspective and improved in " The Spatial Economy" by Fujita, Krugman and Venables (1999). This FKV book is more than a collection of related papers; it is a coherent, self-contained composition that tries to model the centripetal and centrifugal forces of urbanization.

4.5.1 Concepts, Methods and Results

The central concept in new economic geography (NEG) is increasing returns to scale (IRS). Both conventional economic geography (CEG) and mainstream economics had this concept for a long time. However, mainstream economics considered IRS as a situation that violates the convexity of the production function assumption, therefore causing a breakdown of perfect competition (PC). On the other hand, the Marshallian approach to IRS saw it as primarily external arising from the specialization of the social division of labor. Since it was external, economic geographers assumed that PC was still valid. In NEG, the IRS concept was brought into the picture via Chamberlin's monopolistic competition (MC) framework. The MC framework allows to use IRS without loosing competition or assuming externalities.

A fundamental difference between NEG and CEG is of method. NEG relies on forming models that are supported by mathematical proofs. To make these models tractable NEG relies on very simplified and sometimes unrealistic assumptions. However, according to Krugman, as long as the results are adequate the assumptions need not be modified. CEG, on the other hand, has mostly abandoned the use of formal models and is dominated by conjectural models that are based on realistic assumptions. CEG models do not aim to find abstract metaphors for understanding agglomeration effects, but tries to give insight to policy makers.

NEG derives the following main results:

1. Much trade between countries, especially intra-industry trade, is a result of specialization taking advantage of IRS.

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2. Specialization and agglomeration of economic activity is a *historical accident*. Once a region starts to specialize, for whatever reason, IRS ensures that the specialization process continues.

3. The patterns of demand for factors of production under imperfect competition depend on the technology of production at the microeconomic level.

4. Strategic policies enable a region to shift the pattern of specialization in its own favor. Rather than promoting weak industries a region is better off by promoting export sectors where economies of scale have started to work.

4.5.2 New Economic Geography and Regional Development

It is generally assumed that economic and monetary integration will result in regional convergence. As trade barriers are removed, financial markets are integrated, and transportation costs decrease, the firms will be able to better take advantage of any comparative advantage that exists. This will result in capital flow from highly developed regions with costly labor to regions with cheap labor. In the long-run factor prices should equate and the regions will converge. This process is the main driving force behind the formation of EU and EMU.

However, NEG approach is that due to IRS already specialized regions will serve the whole market and due to this further specialization they will grow even more. Therefore, regional convergence will never occur. Even if all regions were non-specialized to start with, the growth of regions relies on historical accidents and it is unlikely that an even growth pattern would emerge.

New Economic Geography and Transportation

There are three major frameworks used for analysis of economic benefits of transportation infrastructure projects:

1. *Macroeconomic benefits*: In this approach, transportation infrastructure projects are considered as a form of physical capital and hence, improvements in transportation infrastructure yield to increase in GDP. However, this approach is a-spatial and is a black-box approach. It does not tell through which mechanisms the transportation infrastructure projects increase GDP.

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2. *Microeconomic benefits*: This approach relates improvements in transportation infrastructure to benefits at the firm level. These benefits include:

i. Logistical adjustments: More reliable transportation services reduce inventory costs through just in time (JIT) manufacturing.

ii. Consolidation of facilities: Reduced transportation costs allow firms to concentrate production and distribution and increase efficiency through scale economies.

iii. Location effects: Lower transportation costs give firms more flexibility in their choice of location so that they enjoy cheaper land and/or knowledge spillovers.

iv. Value added: Better transportation infrastructure allow firms to reach markets where their output has a higher value.

3. *General equilibrium benefits*: General equilibrium benefits occur when improvements in transportation result in a redistribution of resources across regions such that there is an increase in aggregate productivity. There are to channels for these benefits to occur:

i. Comparative advantage: Regions specialize in what they can produce most efficiently given their endowments.

ii. New economic geography effects: The new economic geography (NEG) framework allows us to explain why majority of world trade happens between regions that are very similar in terms of natural resources, physical capital, human capabilities, and institutions. Examples for this point are trade between the US and Canada, or between the EU countries. The lack of trade barriers due to NAFTA and EU is not a sufficient explanation as to why very similar goods are traded between these countries. For example, if automobile production were more efficient in the US then without any trade barriers Canada would not be exporting any cars. Lower transportation costs attained by improved transportation infrastructure would only make this fact more extreme. The answer to this problem lies in the ability of NEG to incorporate increasing returns to scale (IRS) in a monopolistic competition (MC) framework. In a MC framework, each firm produces a unique good which is slightly differentiated from other competing products. Consumers have a love of variety utility function for each firm's unique good. For example, they are happy that there are GM, Honda and Toyota cars which are not perfect substitutes of each other, but are similar products. Due to IRS it is more efficient to have a single site of production for each good. For example, GM and Honda may have production facilities in the US and

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export to Canada, but Toyota may have it vice versa. Therefore, both US and Canada will be exporting cars to each other. However, presence of transportation costs may result in a deviation from this ideal. For example, since cars are relatively costly to transport multiple sites of production are required. Improvements in transportation infrastructure which lead to reduction in transportation costs will help us to get closer to this ideal. Reduction in transportation costs also brings about a less obvious benefit in the NEG framework. Due to this reduction firms will be able to reach broader markets, and coupled with IRS this means higher profits for them. In a MC framework firms actually do not make any profits since new firms will enter. Thus, this mechanism ultimately increases the variety of goods available to the consumers. Therefore, consumers reap two kinds of benefits: reduced good prices and increased variety, both of which increase their utility level. Continuing with the car example, a reduction in transportation costs may enable a firm which has production only in Japan (Mazda) to enter the US and Canadian markets. Thus, the variety of cars increases from three to four.

4.6 Conclusive Remarks

Since late 1970s the field of *New Economic Geography* emerged. The catalyst was the development of tractable models of competition in the presence of increasing returns to scale. In particular, Dixit and Stiglitz developed a formalization of Chamberlin's concept of monopolistic competition that laid the foundation for this field. The cornerstone paper of this field was Paul Krugman's 1991 seminal paper. This was followed by a number of papers by Krugman, Fujita, Venables and Puga. All of this work was put into a single perspective and improved in the FKV book, The Spatial Economy.

Today, as the keynote speaker at the Association of American Geographers (AAG) conference on April,16th, 2010 Paul Krugman calls NEG as middle-aged rather than new, and evaluates its evolution as:

"*It's almost exactly 20 years since I delivered a set of lectures in Leuven that became the monograph Geography and Trade (Krugman, 1991), which most people consider the beginning of the New Economic Geography. It has, from my point of view, been a great two decades .*

What you have to understand is that in the late 1980s mainstream economists were almost literally oblivious to the fact that economies aren't

dimensionless points in space – and to what the spatial dimension of the economy had to say about the nature of economic forces.

A generation ago, mainstream economists hardly thought at all about the location of production within countries; they hardly looked at local and regional data for evidence on such matters as the strength and nature of external economies. The New Economic Geography was conceived as an effort to change all that, bringing economists into an area the best way I knew how: by developing cute, nifty models. That effort has succeeded. There are many ways in which the ongoing work in New Economic Geography can be criticized; one of these valid criticisms is the failure to pay sufficient attention to the work of more traditional economic geographers. But getting economists to think about location and spatial structure is nonetheless significant progress. "

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