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Urban Industrial Relocation: the theory of edge cities

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Abstract

Urban economists have recently focused upon a 'newly recognised' phenomenon: edge cities. In the first part of this paper we review two main interpretations , originating from Krugman and Fujita and the Henderson and Mitra models of this urban phenomenon. After a concise review of these two approaches, we will introduce our model which represents a possible third way of explaining the edge city process. The objective is to examine the conditions under which we can observe a relocation of firms from an urban location to a new extra-urban location and then how this new location can generate a specific urban agglomeration pattern in the form of edge cities.

Our methodological framework is based upon the model of monopolistic competition which examines the economic relationships among firms at each industrial location and the relationships among distinct firms at different locations. These intra/inter relationships are examined from the point of view of complementarity.

Complementarity in our case combines the two notions of (i) firm interaction with cumulative and reinforcing effects and (ii) coordination among firms in local industrial structures. Our interest in this notion stems from the necessity to explain the spatial distribution of firms, particularly the reason why firms in their location decision often choose to cluster. In our model we analyse this aspect of location in clusters from the point of view of the elasticity of substitution.

Keywords: urban industrial location, complementarity, elasticity of substitution.

1.   Introduction

When Joel Garreau published *Edge City* in 1991, this 'newly recognised' phenomenon which is the topic of his book, had already been evolving for 20 years. Garreau identified 123 existing edge cities and 77 emerging ones around 35 of the largest metropolitan areas in the U.S. The edge city was identified as the new form of urbanisation. Such urban developments differ distinctly from the bedroom communities that arose between 1950 and 1970. Edge cities are communities that cluster together typically around big corporate companies that relocate outside the city's CBD. According to Garreau, a spatial development can be defined as an edge city if an extra-urban concentration of residential and office locations has at least five million square feet of office space.

The interest of urban economists in this urban phenomenon has first focused upon the problem of the non-monocentric urban configuration (Fujita and Ogawa, 1982). The mainstream literature then shifted to the specific issue of the edge city. We can identify two branches of thought that examine the effects of agglomeration and dispersion forces in urban areas, although from two different perspectives. In the first stream of studies we may refer to the work of Krugman (1991, 1993, 1996) and Fujita et al. (1980, 1995, 1996), where "the source of agglomerations economies is generated from monopolistically competitive behavior of many small firms which produce a variety of differentiated products" (Fujita and Mori, 1996). Secondly, there is the study undertaken by Henderson and Mitra (1996), which by following the existing urban economics literature (e.g. Hamilton, 1975; Mills and Oates, 1975; Henderson, 1985; Pines, 1991; Mitra, 1994), recognises "the modern urban landscape as being determined by a sequence of strategic choices adopted by 'large agents' or land developers who engineer en masse reagglomeration of people" (Henderson and Mitra, 1996).

Within the available literature there has not yet been an approach to the urban agglomeration process that focuses on the complementarity effect. This is what we propose to do.

We will conduct our analysis within the framework of monopolistic competition rather than from the oligopoly point of view. We have chosen this particular economic model because of its appealing realistic and analytical properties; it is

clear that the paradigm of monopolistic competition is very useful for modelling aggregate firm phenomena, because we can better describe how the elasticity of substitution intervenes in the formation of decentralised urban areas.

The elasticity of substitution is an important concept since we want to focus on the notion of complementarity. "Two phenomena are complementary when they reinforce each other. Their interaction gives rise to a cumulative process. This concept has been used to model business cycles, spatial agglomeration and spatial fluctuation of economic activities, self-sustaining growth and development. Cumulativeness changes the importance given to events. Even small random events can have enormous consequences if they trigger cumulative processes…..On the other hand, complementarity also allows for self-fulfilling expectation outcomes. Complementarity among agents' actions implies that a certain outcome can arise from coordination. If coordination is motivated by a shared belief about the final outcome, that outcome can arise only because everyone believes that it will arise ('self-fulfilling prophecy')" (Ottaviano, 1996). Our interest in the complementarity notion is derived from the necessity to explain the spatial distribution of firms, particularly why firms in their location often choose to cluster. One of the explanations in the literature is that locations in clusters are due to the need to share common infrastructures. However, this is just one of many possible explanations for this phenomenon. In our model, we study this aspect of locations in clusters from the point of view of the elasticity of substitution defined within the monopolistic competition paradigm thus giving another possible interpretation of the edge city phenomenon.

This paper is divided into the following sections. In sections 2 and 3 we review the two approaches on the edge city formation previously described. In particular, in section 2 we analyse two separate models which are grounded in the same concept of the self-organising economy, but which explore two different questions about the edge city process. In section 3 we introduce the model of Henderson and Mitra (1996) which, like that of Krugman (1996), addresses the question of where the urban agglomeration occurs, but by considering the perspective of the large

agents. In the remainder of our paper we discuss our model and its implications for edge city formation.

2.   Self-Organizing Edge Cities

The concept of self-organising systems has been used to examine urban agglomeration processes. There are two main lines from which this concept has been developed. The first approach (Fujita and Mori, 1996; Krugman, 1993, 1996; Helpman, 1995) examines the equilibrium between agglomeration and dispersion forces that determine the economic structure of the city. The second approach of Krugman (1996) investigates the problem of location choice of businesses in an urban area.

The first approach, which consider processes of self-organising economies, is based upon the models of Fujita and Mori; 1996, Krugman, 1993, 1996; Helpman, 1995. These models analyse the forces which determine urban agglomeration and dispersion. The models generally assume the same type of agglomeration forces; in fact, they especially consider the interactions among economies of scale, transportation costs and factor mobility. "The agglomeration force in this case is developed in the following manner. Due to scale economies at the plant level, each variety of differentiated consumption goods called manufactured goods is produced at a single site, while because of transport costs, suppliers prefer to locate closer to markets. On the other hand, the existence of transport costs makes consumers concentrate at locations where a wider variety of products is available, i.e., the location at which manufacturing firms agglomerate" (Fujita and Mori, 1996).

In order to examine the agglomeration process in extra-urban locations, the models need to examine the effect of dispersion forces. In general, they distinguish two types of dispersion forces: first, *local demand pull*, and second, *factor price pull*. The first type of dispersion occurs when a section of the population is dispersed and immobile due to agricultural activities. Since the

4

transport cost of the manufactured goods is costly, some manufacturing firms will prefer to move away from the concentration of the other firms and locate in the agricultural area where there is less competition. The second dispersion force, the *factor price pull*, is a force that can be determined by immobile goods such as land for housing or land needed for production. In both cases the wage rate tends to increase at the location where the manufacturing firms agglomerate due to the immobile nature of the good 'land'; therefore some manufacturing firms will move away from the concentration. All of the models we consider here analyse the effects of transport cost in their determination of the urban structure with consistent results. For instance, Tabuchi (1996), who combined the two types of dispersion forces, observes that for two distinct transport costs for manufacturing goods, the firms usually agglomerate in two locations; whereas for intermediate values of transport cost, the agglomeration tends to occur in one location.

The objective of the second approach, called the model of the Edge City, is well-captured by Krugman: "the purpose of what I am calling the edge city model is to explain, in as minimalist a way as possible, how the interdependent location decisions of businesses within a metropolitan area could lead to a polycentric structure, in which business is concentrated in several spatially separated clusters" (Krugman, 1996). According to Krugman, in order to explain the polycentric urban structure, we have to assume the presence of a tension between centrifugal and centripetal forces (*Criterion* 1). By centrifugal forces he considers the forces that promote dispersion of businesses, and by centripetal forces he refers to forces that tend toward agglomeration of businesses in a certain location. He also assumes that the range of the centripetal forces must be shorter than that of the centrifugal ones (*Criterion* 2). The city is assumed to be one-dimensional. The model defines a *market potential function*, P(x), based upon the concept of desirability. A location is considered desirable not according to its inherent characteristics, but according to the distribution of businesses.

Krugman then runs model simulation to determine the location of businesses. "When you simulate the model, you will find that for a wide range of parameters our abstract metropolitan area does indeed engage in a process of self-

organization. Even if you create an initial spatial distribution of businesses that differs only imperceptibly from perfect flatness, all businesses eventually end up in just a few locations" (Krugman, 1996).

To better understand the regularities of businesses' spatial locations, Krugman first examines the function of business distribution as a Fourier series. By decomposing the function in regular sinusoidal wiggles at different frequencies, he observes that different frequencies determine growth at different rates. For instance, with high frequency fluctuations the positive and negative spill-overs are in equilibrium, thus preventing any growth; low frequency fluctuations are present when negative spill-overs dominate, thus making the location undesirable, so there is once again no growth; with an intermediate fluctuation it is possible to determine a growth in the new location.

In the next section we examine the model of Henderson and Mitra (1996) which addresses Krugman's question of where the firm location process occurs. However, different from Krugman's assumptions, Henderson and Mitra assert that the large agents, i.e. land developers, are the real actors of the formation of these new urban landscapes.

3.   Developers and Edge Cities

Henderson and Mitra (1996) begin their examination of the phenomenon of edge cities by noticing that such a process cannot be classified as a product of urban decentralisation and sprawl, but rather is "the creation of strategically controlled office development by large scale land developers" (Henderson and Mitra, 1996). Such a definition of an edge city determines the relative perspective from which the economic model will confront this new urban agglomeration. The model emphasizes the role of large developers who through massive urban planning projects, can then direct the decision of the atomistic agents. This is the major departure from the previous models, in which the atomistic agents are the main developers of urban landscapes.

Such a point of view is nearer to the description given by Garreau of the edge cities formation: "the developers viewed edge cities the same way they viewed America itself: as problem-driven, not ideology-driven. In this way, their perspective was quite the opposite of the designers…Developers saw edge cities as very much the product society. They viewed themselves as utterly egalitarian observers, giving people what they repeatedly demonstrated they desired, as measured by that most reliable of gauges: their willingness to pay for it" (Garreau, 1988).

The model of Henderson and Mitra (1996) is grounded upon the model of Fujita and Ogawa (1982) and is therefore based on linear space with two urban locations: a port city and a potential edge city. To maximise his profit, the edge city developer will choose the linear distance, y, from the port city to where the edge city will locate, the business capacity, K_1, and the labour force, B. The firms in each district are identical so in the model this district is described as district production.

In the model the maximisation of the developer profit occurs through the trade-off among these three variables, which then determines the location choice for the edge city. The results from the maximisation problem ensure that the optimal edge city location changes as the business capacity of the port city changes. In the strategic decision of the distance y, the developer must consider three possible operative effects (1) "as the developer lowers y and moves her center towards the port, that raises the commuting and land rent costs which her workers incur and must be compensated for. So it raises her costs. (2) On the other hand, lowering y means that communications with the port are less decayed and edge city productivity rises. (3) But as a third factor, lowering y also increases port city productivity and port city competitiveness, thus reducing the edge city's monopsony power" (Henderson and Mitra, 1996).

 The location choice of the edge city depicts a *zig-zag pattern* as the business capacity of the port city increases. We then obtain a result similar to Krugman's model, but from a very different approach and point of view. On this matter,

Henderson and Mitra explore the *zig-zag pattern* of the model with a simulation analysis in the different regimes that the port city and the edge city can assume. The observed jumps from one regime to another, different from Krugman's model, do not occur by an incremental trend with the change of the business capacity, K_0, of the port city, but instead they move the edge city location from near to far away from the port city by a 'spatial chaotic pattern'. This result constitutes the main feature of the model, which as Henderson and Mitra observe, although "in a complex but fascinating fashion", underlines a very plausible explanation of a consistent pattern of developers in their location choice.

Edge city formation is, however, a complex phenomenon which cannot be fully explained through the models we have reviewed. An important feature of such a complex phenomenon as the edge city is the existence of variety and its positive effects in the economic context. How variety influences urban agglomeration processes is the question we address in our model.

4. A Model of Spatial Monopolistic Competition

Variety is strictly related with the concepts of complementarity and substitutability. In order to examine the relationship between these two concepts, we choose as a framework for our analysis the model of monopolistic competition of Dixit and Stiglitz (1977) .

Let us assume two groups of goods which can be found in location 1 and location 2. In locations L_1, n_1 firms locate; and in L_2, n_2 firms locate. We assume that n_1 is greater than n_2 and $n_1 + n_2 = 1$. Each firm produces only one product. The utility function of the 'representative' consumer is a two-tier function, $V(X_1, X_2)$, where V is an homothetic function. The subutility function is defined as follows:

$$X_i = \left[\int_0^{n_i} [x_i(z)]^{1-\frac{1}{\sigma}} dz \right]^{\frac{\sigma}{\sigma-1}} ; \qquad\qquad \text{i} = 1, 2 \qquad\qquad \textbf{(1)}$$

where: σ is the elasticity of substitution; we assume $\sigma > 1$;

$x_i(z)$ is the consumption of product z of group i;

n_i is the product variety which is offered in each group i.

σ, according to the definition of the CES function, is the elasticity of substitution of the goods produced in each group, i.e. it is the intra-group elasticity of substitution. The value of σ must always be greater than 1; in this way we imply that no input is essential. Such a condition is dictated by the fact that we are in monopolistic competition, which implies that the marginal revenue must be positive.

We assume that $p_i(z)$ is the price of the differentiated product z of the group i and we define a price index for group i:

$$P_i = \left[\int_0^{n_i} [p_i(z)]^{1-\sigma} dz \right]^{\frac{1}{1-\sigma}} . \qquad (2)$$

When the consumer maximises his utility. We can derive the demand function for each product z:

$$x_i(z) = \left(\frac{p_i(z)}{P_i} \right)^{-\sigma} X_i ; \qquad\qquad i = 1, 2 \qquad (3)$$

$V(X_1, X_2)$ is an homothetic function then we assume that:

$$\frac{X_1}{X_2} = \phi\left(\frac{P_1}{P_2} \right) . \qquad (4)$$

The production of the differentiated good i involves a marginal cost a_i. The producer will decide to enter by choosing the price that maximises his profit:

$$\max_{p_i} \left[(p_i(z) - a_i) x_i(z) \right] \qquad . \qquad (5)$$

By applying the inverse elasticity rule we obtain:

$$p_i(z)\left(1 - \tfrac{1}{\sigma}\right) = a_i \qquad . \qquad (6)$$

This result is valid for all i and z. The price and quantity of products can be proven to be the same for all firms in the same group. We can therefore write:

$$X_i = n_i^{\frac{\sigma}{\sigma-1}} x_i \quad ; \tag{7}$$

and

$$P_i = n_i^{\frac{1}{1-\sigma}} p_i \quad . \tag{8}$$

We can now also present the profit, π_i, for each firm as:

$$\pi_i = (p_i - a_i) x_i \quad ; \tag{9}$$

by substituting in equation (9) the equations (6), (7) and (8), we find:

$$\pi_i = (p_i - a_i) x_i = (p_i - p_i(1 - \tfrac{1}{\sigma})) x_i = \frac{p_i}{\sigma} x_i = \frac{1}{\sigma} \left(\frac{X_i}{n_i^{\frac{\sigma}{\sigma-1}}} \frac{P_i}{n_i^{\frac{1}{1-\sigma}}} \right) = \frac{X_i P_i}{\sigma n_i} \quad . \tag{10}$$

The producer needs to decide in which group to locate. Such a decision will be based upon the relative profit of each group:

$$\frac{\pi_1}{\pi_2} = \left(\frac{n_2}{n_1} \right) \left(\frac{P_1}{P_2} \right) \left(\frac{X_1}{X_2} \right). \tag{11}$$

We need to specify also the upper-tier function $V(X_1, X_2)$ in order to reduce equation (12). Let us assume that V is a CES function:

$$V(X_1, X_2) = \left[\alpha X_1^{1-\frac{1}{\varepsilon}} + (1-\alpha) X_2^{1-\frac{1}{\varepsilon}} \right]^{\frac{\varepsilon}{\varepsilon-1}} \qquad 0 < \alpha < 1 \quad ; \tag{12}$$

where ε is the elasticity between X_1 and X_2 and represents the interelasticity of substitution, while σ is the intraelasticity of substitution. We can now define the rate of technical substitution (RTS) as :

$$RTS = \frac{\alpha}{1-\alpha} \left(\frac{X_2}{X_1} \right)^{\rho+1} \qquad where \; \rho = \frac{1-\varepsilon}{\varepsilon} \qquad . \tag{13}$$

By equating RTS to the input price ratio:

$$\frac{\alpha}{1-\alpha} \left(\frac{X_2}{X_1} \right)^{\frac{1}{\varepsilon}} = \frac{P_1}{P_2} \quad ; \tag{14}$$

we substitute this result into equation (12), through which we obtain:

$$\frac{\pi_1}{\pi_2} = \left(\frac{n_1}{n_2}\right)^{\frac{\sigma}{1-\sigma}}\left(\frac{a_1}{a_2}\right)\left(\frac{1-\alpha}{\alpha}\right)^{-\varepsilon}\left(\frac{a_1}{a_2}\right)^{-\varepsilon}\left(\frac{n_1}{n_2}\right)^{\frac{-\varepsilon}{1-\sigma}} = \left(\frac{n_1}{n_2}\right)^{\frac{\sigma-\varepsilon}{1-\sigma}}\left[\left(\frac{a_1}{a_2}\right)^{1-\varepsilon}\left(\frac{\alpha}{1-\alpha}\right)^{\varepsilon}\right] =$$

$$= \beta\left(\frac{n_1}{n_2}\right)^{\frac{\varepsilon-\sigma}{\sigma-1}} \tag{15}$$

Equation (15) implies that the relationship between profit and product variety depends on the relationship between intergroup and intragroup elasticity of substitution. In their model, Dixit and Stiglitz (1977) assume that the intragroup elasticity of substitution is greater than the intergroup one, and they consider it implausible that the entry of a firm could increase the profit of the firms, which in terms of elasticity of substitution, could mean the possibility for the intergroup substitution to be greater than the intragroup one. Such a restriction in the Dixit and Stiglitz model ensures that the solution of the model is unique and stable and it suits the objective of the model analysis, i.e. the identification of an optimal level of goods differentiation. However, to analyse the cumulative processes that characterise the formation of edge cities, we need to forego this restricted assumption and examine how the variation of the two elasticities of substitution can generate a spatial economic equilibrium in the model. This will be done in the next section.

5. The Long-Run Equilibrium

In the present section we will re-examine equation (15) under long-run equilibrium conditions. The key point of the problem is the interpretation, in equilibrium, of the values of the elasticity of substitution, i.e. ε and σ, and by the factor, β. The intraelasticity of substitution identifies the complementarity among products of each industry. According to the definition of complementarity of Hicks-Allen (1934), what makes a pair of products complementary to each other is the presence of a third product, rather than the physical characteristics of the

two products. In other words, the notion of complementary goods should be based on the property of market demand.

Let us consider locations 1 and 2, and assume that location 1 is a developed city, while location 2 is a possible new urban agglomeration; thus implying that $n_1 > n_2$. We additionally assume zero re-location cost. In this case we analyse when $\sigma > \varepsilon$, i.e. the intraelasticity of substitution is larger than the intergroup elasticity of substitution. The equation :

$$\frac{\pi_1}{\pi_2} = \varphi = \beta \left(\frac{n_1}{n_2} \right)^{\frac{\varepsilon - \sigma}{\sigma - 1}} \quad , \tag{15}$$

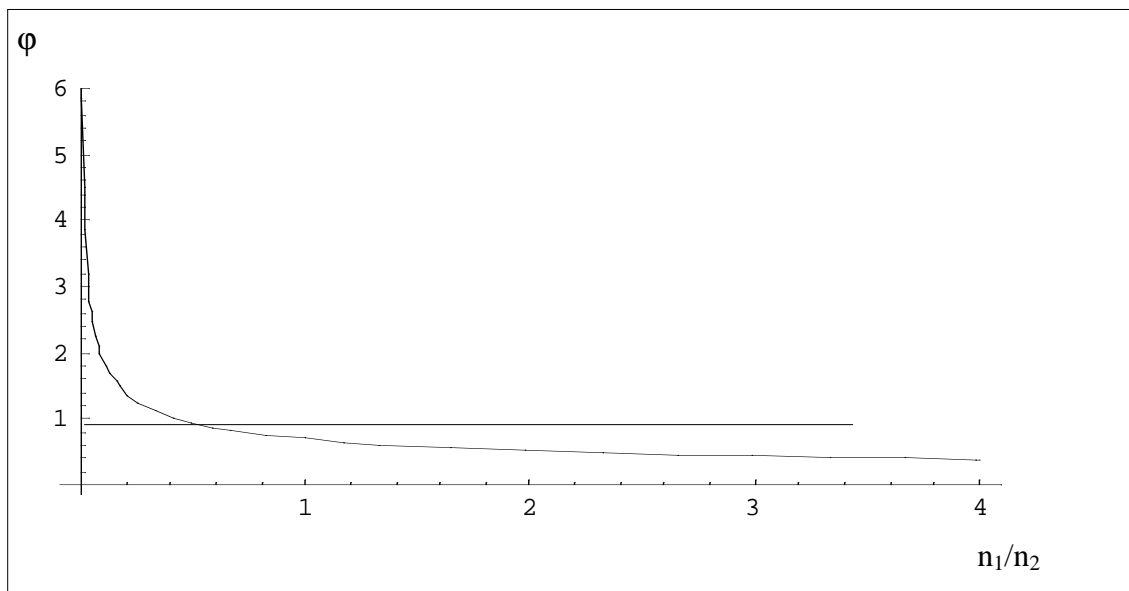can be shown to be a monotonic curve (see Figure 1).

Figure 1.   Case for intragroup elasticity of substitution greater than intergroup elasticity of substitution.

In this case the clustering of firms is due to the 'similarity' of the firms in each group. Each firm that will locate in the new area will reduce the demand for any competing product and then decrease the possibility for new entries; this is depicted by the downward slope of φ. We have assumed that the products are substitutes; this implies that the negative effect of new entries will dominate a possible increase of demand due to the increase of a variety of products. For example, we observe that banks, restaurants and bookstores cluster together

creating what we can call a 'pole'. Each firm that enters in the pole will exert a negative feedback to the other firms in the pole due to the fact that the profit level is negatively related to variety.

Matsuyama (1992) observes that substitutability can be expressed, as in our case, from two different perspectives. First, there is the Hicks-Allen notion, which is concerned with the decline of the product demand when prices decline within the group of products. This implies that the Hicks-Allen partial elasticity of substitution is negative. Second, there is the notion of the relative profit. A new firm wanting to enter in the pole will reduce the incentive for other firms to enter.

Let us now consider the alternative assumption of $\varepsilon > \sigma$. *Ceteris paribus*, we observe that the curve (see Figure 2) depicts a different situation. In this case the entry of a new firm in a pole will generate a positive effect in the other firms, i.e. a profit increase. Such a positive feedback will determine an expansion of the variety in location 2.
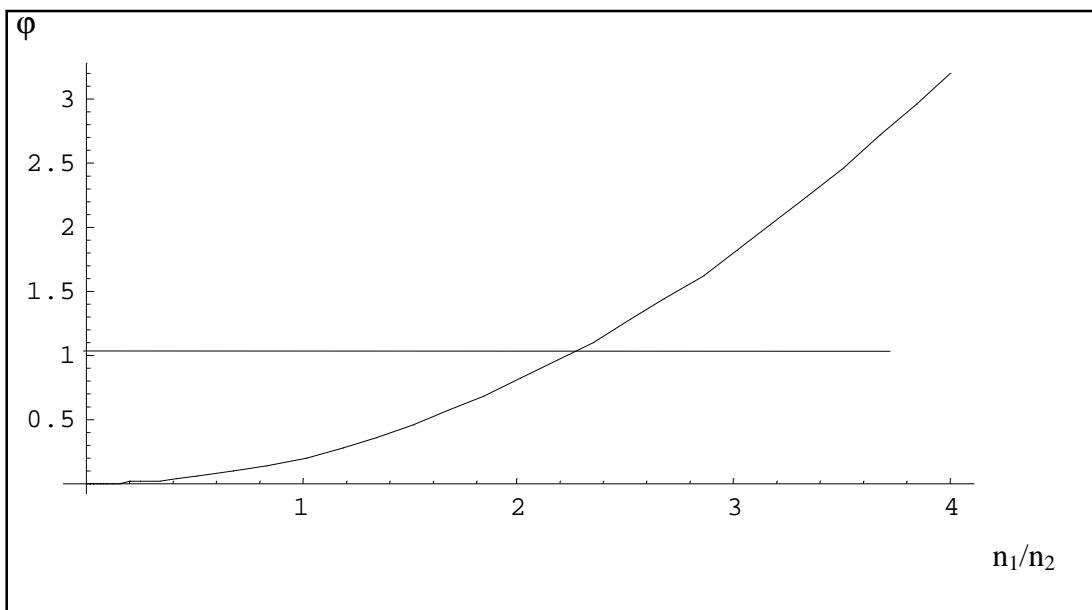

Figure 2.   Case for intergroup elasticity of substitution greater than intragroup elasticity of substitution.

In this case we have three equilibrium points. Two are on the boundary which correspond to the complete concentration in one location, i.e. $n_2 = 0$ and $n_2 = 1$, and one is the internal solution. The internal solution is however, unstable, so we

cannot consider it as one of the solutions for the long-run equilibrium. This issue will be dealt with below in greater detail (section 6).

We have assumed that the intraelasticity of substitution in this case is greater than the interelasticity one, i.e. we assume that the goods in the group are complementary. The Hicks-Allen partial elasticity of substitution is positive. "Intuitively, when other shops in your area reduce their prices, you lose some of your customers; σ captures this business-stealing effect. Yet, your sales may still go up if the lower prices attract customers to your area, the effect captured by ε, more than enough to offset the business-stealing effect. If this is the case, then your shop and other shops in your area are complementary to each other in the sense of Hicks and Allen" (Matsuyama, 1995).

But if the internal equilibrium in this case is unstable why do we need to consider the case when the goods in each group are complementary? To answer this question, we will examine in section 6 the relevance of both cases of monopolistic competition in an urban economic context and, in particular, how to determine their relevance to the phenomenon of edge cities.

6. The Reasons for Clustering: Edge Cities

We can now re-examine equation (15) in order to study the relationship between inter- and intraelasticity of substitution by presenting some simultaneous results. Let us assume that n_1 equals 0.7 firms, n_2 equals 0.3 firms, and β equals 1. The graphs (see Figure 3) depict --from two different points of view-- the tridimensional relationships between both the elasticities of substitution and the profit ratio.
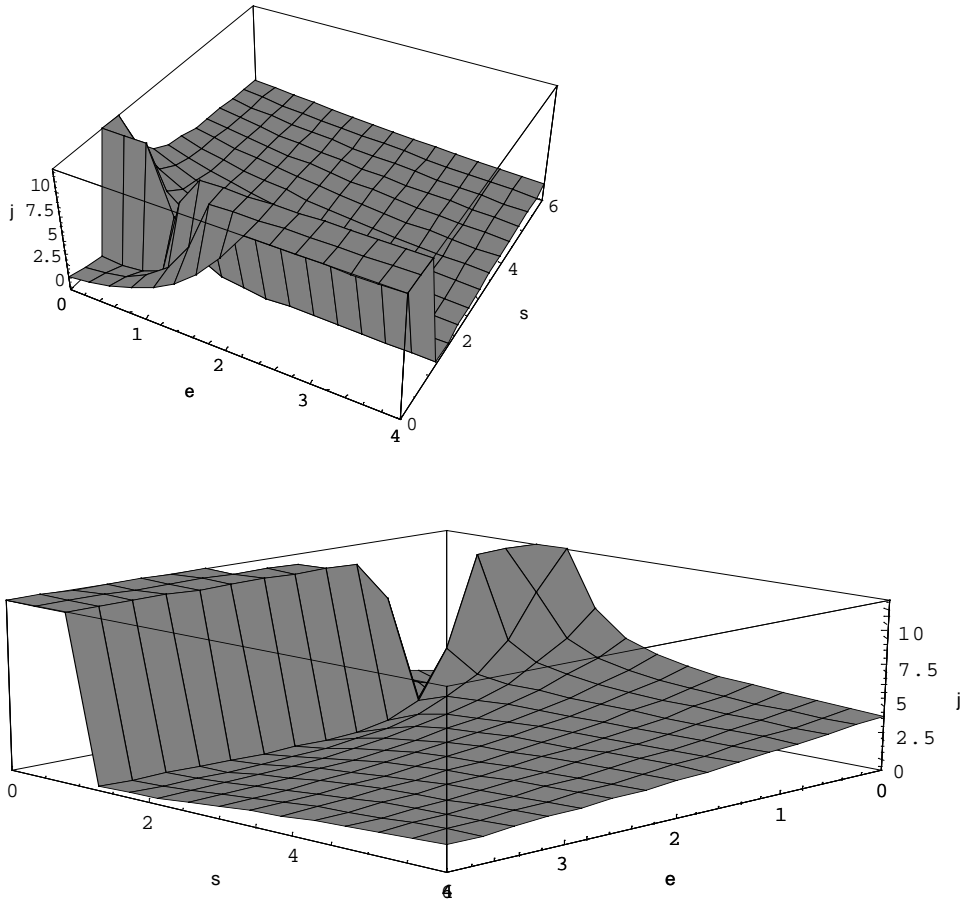
Figure 3.   Tridimensional relationship among ratio profit (φ), interelasticity of substitution (ε) and intraelasticity of substitution (σ), given $n_1 = 0.7$ and $n_2 = 0.3$.

As we have seen earlier, σ and ε vary in relation to each other. From the graphs we observe that as ε increases its value, σ decreases its value. And after a certain value of ε, which is between 1 and 2, σ becomes constant. These points, which have σ constant, are the points where $\varepsilon > \sigma$ and therefore indicate the internal unstable equilibria. This implies that when we reach an unstable equilibrium the value of the interelasticity of substitution will continue to increase. These unstable equilibria allow us to observe that multi stable equilibria must also exist. This observation is very important in the light of urban agglomeration phenomena in relation to edge cities.

In our discussion we have examined the notion of substitutes and complements not from the standard terms of 'nuts and bolts', but by observing that two goods

are substitutes or complements in relation to the general equilibrium interactions. We want to argue that substitutability and complementarity are not intrinsic characteristics of goods, but rather they are related to the number of goods available in the economy. By extending the paradigm of monopolistic competition to the case where the intergroup elasticity dominates the intragroup elasticity, we want to focus on the interdependence of firms when they are faced with a relocation decision. Then we have to practically widen the approach, since we have to assume that the clustering of firms can not only happen under the substitutability effect, but also under different regimes such as technical similarity or geographical proximity.

Matsuyama (1996), who has investigated this topic, recognises three possible cases where a clustering process can appear under the assumption that the intergroup elasticity is greater than the intragroup one.

1. Shopping districts. We know from direct experience that by going to a shopping mall we expect to find a large assortment of goods and services. Shoppers generally prefer shopping districts/malls where a great variety of products is available, e.g. shops, restaurants, cinemas. This implies that many shopping malls have a similar variety of products and are therefore much closer substitutes to each other than shops or restaurants of the same shopping district are to each other.

2. Regional economies. Let us consider two regions that produce two goods which are close substitutes to each other and are highly specialized in their production by providing a wide range of complementary services. In this case, Ethier (1982) and Romer (1987) observe that, as in the previous case, we have $\varepsilon > \sigma$ and the highly specialized character of both economies determines a diversity between the two locations and thus an increase in the economic efficiency.

3. Technology choices. Suppose that we have two technologies which are competing with each other. Various goods are available which are produced based on either technology. The two technologies are incompatible. Also in this case the products provided are similar, but consumers will always prefer the technology that offers a greater variety of products.

By considering these observations we can conclude from the analysis of our model that urban agglomeration occurs either under the substitutability effect or under the effect of complementarity. When the intraelasticity of substitution is greater than the interelasticity of substitution, we know that the more substitutable are the products, the lower the price, thus attracting customers to the area where the effect occurs. As a consequence, this will instigate an urban agglomeration process. On the other hand, if the interelasticity of substitution is greater than the intraelasticity of substitution, we know that the less substitutable are the products, the higher the price. However, the fact that the interelasticity of substitution is higher in this case implies that in the location we have a great variety of products, and we can therefore offset the negative effect of the higher prices by offering a greater variety of products to the customers. Also in this case we can see that by attracting customers to the area, we can produce an urban agglomeration effect.

This fact has an intriguing policy implication, well known by urban planners but sometimes opposed by economists (see Evans, 1992):;namely that variety is a fundamental feature of the urban agglomeration. By *variety* we mean multiplicity of goods and services present in the economy as well as agents acting within this system. We have shown how, from an economic point of view, variety can be introduced in order to create an urban agglomeration and then to offer a possible explanation for edge city formations. To reach this conclusion, we have to define clear analytical conditions, since a loss of stability in the economy which appears when we examine unstable equilibria may give rise to cyclical behaviour. This is of course the subject of further research.

7.   Conclusion

In this paper we have analysed the way to extend the model of monopolistic competition (Dixit and Stiglitz, 1977) to justify urban agglomeration processes

such as edge cities. Our model discusses the question of the stimuli for economic growth and thus the development of an edge city if an urban agglomeration occurs in decentralised locations. This perspective appears to differ from the current literature, presented inter alia of Krugman (1991, 1993, 1996), Fuijta et al. (1980, 1995, 1996) and Henderson and Mitra (1996).

In our model we have relaxed the constraint of Dixit and Stiglitz (1977), who assume that the intragroup elasticity of substitution is greater than the intergroup one. By assuming the possibility of a change in the direction of this disequality of the two elasticities, we have found the justification for cumulative effects and the interactions among firms which may determine the spatial agglomeration and spatial fluctuations of economic activities. In the model we observe that the formation of the edge city may be due to substitutability and complementarity effects. In particular we have introduced the Hicks-Allen (1934) notion of complementarity, which asserts that goods are complements in relation to the market demand and not to their intrinsic qualities.

With this assumption we justify that the urban agglomeration process occurs either under substitutability effects or under the effects of complementarity. This raises the problem of multi-equilibrium solutions, where unstable equilibria identify a perturbation in the spatial economic configuration. The policy implication which we glean from the results of our model points at the crucial importance of product variety in the formation of edge cities.

REFERENCES

Dixit, A.K. and Stiglitz, J. (1977). "Monopolistic Competition and Optimum Product Diversity". *American Economic Review* 67: 297-308.
Ethier, W.J. (1982). "National and International Returns to Scale in the Modern Theory of International Trade". *American Economic Review* 72: 389-405.

Fujita, M. and Ogawa, H. (1982). "Multiple Equilibria and Structural Transition on Non-Monocentric Urban Configurations". *Regional Science and Urban Economics* 12: 161-196.

Garreau, J. (1988). *Edge City*. Anchor Books: New York.

Hart, O.D. (1985). "Monopolistic Competition in the Spirit of Chamberlin : a general model". *Review of Economic Studies* 52: 529-546.

Helpman, E. and Krugman, P.R. (1985). *Market Structure and Foreign Trade*. Harvester Press: Brighton, Sussex.

Henderson, V. and Mitra, A. (1996). "The New Urban Landscape: developers and edge cities". *Regional Science and Urban Economics* 26: 613-643.

Hicks, J.R. and Allen, R.G.D. (1934). "A Reconsideration of the Theory of Value". *Economica* 1: 52-76.

Krugman, P. (1991). "Increasing Returns and Economic Geography*". Journal of Political Economy* 99: 483-499.

Krugman, P. (1993). "On the Number and Location of Cities". *European Economic Review* (May).

Krugman, P. (1996). *The Self-Organizing Economy*. Blackwell: Cambridge, Massachusetts.

Krugman, P. and Venables, A.J. (1995). "The Seamless World: a spatial model of international specialization". *CEPR Discussion Paper* 1230.

Matsuyama, K. (1992). "Making Monopolistic Competition More Useful". *Working Papers in Economics*, E-92-18. Hoover Institution, Stanford University.

Matsuyama, K. (1995). "Complementarities and Cumulative Processes in Models of Monopolistic Competition". Journal of Economic Literature 33:701-729.

Ottaviano, G.I.P. (1996). "Monopolistic Competition, Trade, and Endogenous Spatial Fluctuations". *CEPR Discussion Paper* 1327.

Romer, P.M. (1987). "Growth Based on Increasing Returns Due to Specialization". *American Economic Review Papers and Proceedings* 77: 56-62.