FDI: AN EVOLUTIONARY/COMPLEXITY PERSPECTIVE

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Abstract

The paper looks at the locality question in Foreign Direct Investment (FDI) theories. For a long time the locality issues in FDI seem to have been overshadowed by globalism. Locality issues, however, have been kept alive from two angles one of which includes diverse individuals who are sympathetic to the underdog. The other comprises a small branch of FDI theorists (Uppsala School) who pay some attention to locality from a pre-Santa-Fe evolutionary perspective. The existence of this tendency has encouraged us to explore evolutionary thinking a little further. Here we attempt, as a beginning, to apply certain evolutionary and complexity concepts to the behavior of FDI.

Key words: evolution, complexity, FDI, rugged landscapes, self-organisation

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INTRODUCTION

Until recently, trade theorists offered a world of perfect competition with factor price equalization. FDI theorists discovered an imperfect differentiated market and yet came out with a 'perfect' mechanism that solved all the problems of trade barriers, locality, transaction costs, diffusion of technology, and even environmental pollution (Kindleberger, 1969;Vernon, 1974; Buckley and Casson 1976; Williamson, 1975; UNCTAD, 1994). These theories grew from the demolition of the Hecksher-Ohlin version of comparative advantage in factors of production and proclaimed competitive advantage for the firm-specific ownership of technology (Rugman, 1983).

The 'perfect' mechanism to exert these advantages was through ***internalisation*** (Buckley, 1992), but of course with a bit of help from local advantages such as cheap labour, natural resources, and stock markets (Singh and Jun 995; Dunning 1998; Caves 1971). In this way, the main body of FDI theories, despite their increasing focus on competitive advantage, continued to live with the contradictory recognition of trading in factors of production and short term investments. This was particularly evident from the trade-linked theories which tried to link trade theories with FDI. The large collection of papers in Buckley (1992) appears to be more trade-tolerant than the earlier works by Buckley and Casson (See for instance Gray 1992, Clegg 1992, Kasteli 1991, and Krugman 1991, which can also be enlightening in this regard)

This recognition of factors of production and locality is most obvious in Cave's emphasis on resource rent, and comes through indirectly in Dunning's combination of technological rent and factor-based rents accruing from his location element. Hence probably the appellation 'eclectic

theory' in Dunning (See Caves, 1971, 1974; Dunning, 1979, 1983, 1995,1998). The fundamentals of these theories, however, were mostly developed long before the extensive outflow of FDI beginning with 1988.

The ideal type FDI was long-term and diffusive of technology. But with a prolonged crisis in Latin America and south East Asia doubts began to prevail. Serious economists like Stiglitz and Krugman produced caustic material leaving little or no space for the old optimism in the running of the global economy. Having studied the Asian Crisis in depth (Piranfar 1999a), we tend to believe that the phenomenal growth of FDI must have been subject to many impurities such as cross-border intrusion of portfolio capital and trade in locally embedded factors of production. Otherwise FDI could not have dropped by around one quarter during the crisis. These among other things may result in what we call ***sticky evolution*** amounting to over-adapted evolution, which will be discussed later.

These events must have shattered the idealist image of the evolutionary entrepreneur who, according to the Scandinavian model, moved from trading with neighbors to licensing, and then investing in culturally and physically distant locations. Vernon had a similar view. His product lifecycle involved exporting until the goods were mature and less profitable, which then would be produced overseas. Vernon was forced to repent as he had involved locality-based factors of production in his model and had used an evolutionary framework long before these concepts were introduced in economics.

The Scandinavian model, or Uppsala School of thought, was received more favourably as it went along with the main tenets of the mainstream FDI theories. This outlook was only criticised for its generalisation of a Nordic-specific situation in Scandinavian history
But more importantly it was observed that the process can also be reversed as for example the industrialised countries have 'evolved' to invest in similar countries after a bout of adventure in developing countries (Buckley and Ghauri, 1999). The so-called ‘flight. to quality’, namely the homecoming of capital to the advanced countries, where it has a safe haven, is a proof of this reverse evolution.

Application of evolutionary concepts to economics is generally a difficult job. A few businesses may find a niche and grow there in an evolutionary context, but the majority is subject to immense chaotic movements outside their reach and swerve in all directions. These enormous waves at global level may engage in evolutionary processes. But certainly they will defy any simplistic evolutionary views as variables change from within, impact each other, and transform into one another (this is almost a picture of the correlated rugged landscapes).

Our view is that FDI, trade in locally-based advantages, and a variety of financial forms including portfolio investment may follow a complex evolutionary pattern involving a considerable amount of metamorphism that allows for mimetic local adaptation, deeper adaptation and longer delays due to rugged correlated landscapes. Cantwell (1994) has briefly introduced the concept of "learning" into FDI theories, which seems to grow in the direction shown by Lall's (1981) insightful concept of 'total involvement'. These are theories that allow for a more complex route and are in essence more tolerant compared to the outlook in the

internalisation camp. These views are perhaps as tolerant of diversity as Dunning's eclectic theory, but seem to be more dynamic and evolutionary in essence. As can be anticipated, Lall has produced more scholarly works since, and has apparently drifted more towards evolutionary concepts, a little like Krugman, without fully adapting to this outlook.

Now that the internalisation zeal is waning, the development of an evolutionary view of FDI, which pays more attention to locality, seems to be highly desirable. In this paper we attempt a brief journey in Kauffman's rugged landscapes to see how the adaptive search of global capital behaves locally.

BACKGROUND TO EVOLUTIONARY THINKING IN FDI

Taking an adaptive walk in the rugged landscapes rather than trundling along in the smooth roads of the internalisation-based FDI theories stems from the fact that FDI theorists have already felt the need to explain FDI in evolutionary terms. This feeling has been expressed in a variety of ways: First of all FDI is an evolutionary phenomenon irrespective of the theorists' awareness. It sprang up from the necessity of overcoming the trade barriers erected by many nations poor and rich for different reasons. The rich nations wanted the local producers' votes whatever the dictates of comparative advantage e.g. growing sugar beets in the UK, and the poor were in the grip of import substitution theories and wanted to gain economic independence in a world that was evolving towards interdependence. These barriers could have been overcome by negotiations or by using guns. That would not have been evolutionary.

FDI was an innovative way to overcome the barriers rather like the long jumps in Kauffman's landscapes (more of this later). In the heat of this change, most theorist were concerned with justifying the change rather than pondering over its evolutionary context. They came out with the concept of *internalisation*.

It is quite likely that the overemphasis on internalisation is rooted in this subconscious awareness of FDI's evolutionary role by those 'internalisers' who were not familiar with modern evolutionary concepts. Internalisation basically means that the Multinationals faced with trade and other barriers produce goods and services internally in overseas locations which beats the local competitors. This is quite simple, but the idea came with a tempest. The proponents of this view wanted to say that they had a new idea, which reflected a necessity. The feeling was expressed as a rage against the old Neo-classical concept of comparative advantage with clear locality implications. The necessity was explained in terms of better technology and organisational economy. Unaware of evolutionary concepts most did not know how to express their passion, but some, like Hymer, thought the necessity was dialectical, and so continued with promoting the idea with scientific soberness. For Hymer, internalisation carried an evolutionary but also an unexpressed revolutionary message.

A second group of people who seemed to absorb an evolutionary message in FDI consisted of individuals of diverse persuasions. There are many that use the word evolution to mean the well-worn concept of economic development. It is the same story as calling developing countries as emerging markets not knowing that emergence is a big concept in evolution. Some are aware but remain non-committal. Lall is a prime example.

Lall is mostly known for his 1981 paper that put 'Total Involvement' in FDI dictionary. Somewhat like Dunning's eclectic theory, the concept of total involvement acted as a peacemaker. For him FDI and trade were both part of the general process of globalisation. In his later works, especially in his latest work for ILO and a 1999 book Lall has shown a good knowledge of evolutionary thinking in particular in dealing with the international diffusion of technology, though with a cool pragmatic detachment. His sole reference to the old Nelson and Winter (1982), however, may imply some distance. Not just because of the age of this work but because of its political economy that stands against those 'selectionists' who do not understand economics. (Selectionists are a group of evolutionary thinkers who argue against the adaptationists)

Campbell is very much in the same mold but seems to be closer to evolutionary thinking. He is concerned with technology which is one of the most favorite areas of research for evolutionists, the other main area being the application of Neural Networks to finance. Campbell has also shown a good understanding of evolutionary learning, which is rather new to economics. Among the most prominent sole riders who have shown an early understanding of the evolutionary approach to FDI is Aharony (See Buckley and Ghauri 1999).

Prominent FDI thinkers who are now more tolerant of trade theories have now adopted evolutionary- complexity view but have yet to show a research work to demonstrate a full knowledge. For many complexity only means things are too complex! The recent collection of

FDI works by Buckley and Ghaury (1999), however is a good source of the Scandinavian evolutionary thoughts on FDI.

The Scandinavian approach to marketing and investment is clearly evolutionary. Hallen and Wiedersheim-Paul (1999), originally printed in 1979, is one of the original sources The internationalisation process discussed in this work involves gradual radiation outwards both physically (hard distance) and psychically (cultural or soft distance). The investor starts with searching the locality which is culturally nearer, then moves to culturally remote areas. Their approach is more in tune with internationalisation than with internalisation. The adaptive search in Kauffman, as will be discussed in more detail below has a similar approach in terms of starting with the local entities and ending in local optima.

FDI and the Rugged Landscapes

Despite the sound of it, Rugged Landscapes is not a geographic term. It is a three dimensional search space for entities (from biological to economic) to improve their capabilities. Its geographic connotations, however, is not misleading. Rugged landscapes always provide refuge to minorities and diversities. Similarly, in Kauffman's landscapes when entities reach a rugged locality, they do linger on there longer than in smoother surroundings. They linger on and even may die there, but never stop aspiring for the heights. Thus these entities have a close affinity with investment capital that insatiably is searching for highest profit and lowest costs, but often do get stuck in localities despite their intrinsic desire for the heights. The lengthy stop in the locality stems from a variety of facts: You are not able to see the summit because of the topology. You stay because you feed on the locality and lift yourself gradually in terms of energy

or capital. Or you are preparing for a long jump over the hills. A more important discovery is that as you get nearer the top, beyond the midway, the search becomes more cumbersome, which adds to the gravity of locality. It is not too difficult to see a hint of diminishing returns here. These discoveries are common sense but are rooted in serious science.

The NK Model.

Kauffman's NK model aims at showing the difficulty and complexity of search in fitness landscapes and therefore the necessity of self-organisation. In evolutionary thinking there is a chasm between those who emphasise adaptation and those who give Darwinian selection a big role. Stuart Kauffman tends to synthesize the two tendencies by introducing self-organisation. It would take too long to go into self-organisation in biology, but for economists it is like Adam Smith's invisible hand. Self-organisation is a complexity issue and is related to K, the interdependence of the entities, which can range from 0 to N-1 where N represents the total number of entities in the space under study.

The NK model looks like this:

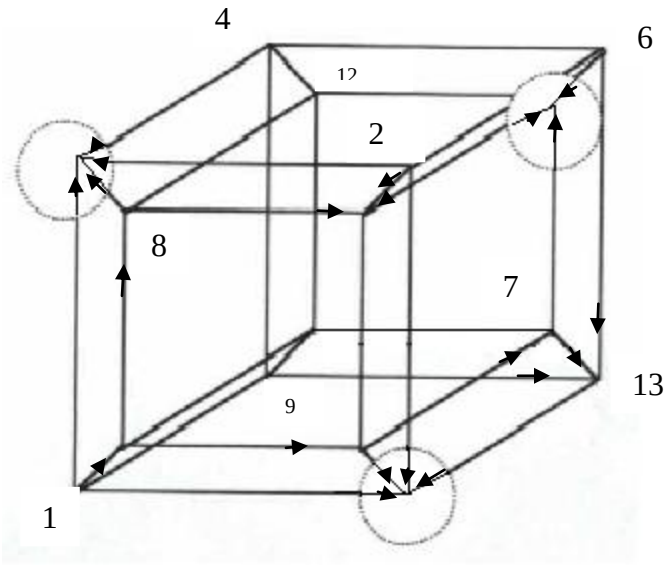
$$L = 2^N \text{ given } K. \qquad k\ (0, N-1)$$

L stands for fitness space, which consists of 2^N possible types of entities. K is a parameter for the degree of epistatic interactions described above. Before considering K let's visualise the non-epistatic random search. To use biological language consider a genotype (population of genes)

with only 4 genes each having 2 alleles (attributes) 0 and 1. This gives us $2^4 = 16$ genotypes in the fitness landscapes is shown as the following algorithm:

(0000), (0001), (0010), (0100), ... to (1111).

If 0000 is the minimum energy (or profit for FDI), and 1111 is the highest value then we have a search landscape. If we rank these values from 1 to 16 placing them on the vortexes of a Boolian hypercube, we can see a random search with 3 local foci for the highest local values where highest number of arrows gather.



As values are assigned randomly and are independent, so we have a random fitness landscape. One of the main properties of this kind of random landscape is that it is full of local optima creating too many stoppages. At lower levels adaptation is too easy, and if N is large there is no

escape from local optima. But at each stop upwards the number of footpaths drop by one half. Another property is that any mutation would shift the whole population, whereas with minimal complexity, say with K = 8 we have interdependencies that control rapid shifts.

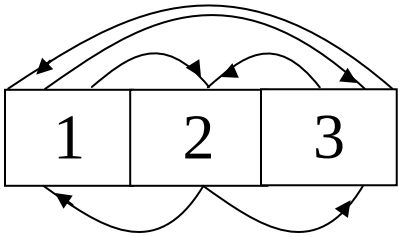
Correlated Fitness Landscapes

Suppose we are talking of an organisation. If K = 0 then each attribute such as strategy, personnel system or structure is independent of all other attributes. At the other extreme if K = N -1, then the fitness contribution of any one attribute depends on the value of all other attributes. To illustrate suppose we have N = 10, and K = 3, then we have a string of attributes such as: 1, **0, 0, 1**, 1, 1, 0, 1, 0, 0. The value of each element in the string, e.g. the first 1, depends on the K = 3 successive values in the string which are 0, 0, 1 here as highlighted in the string. Thus larger K means greater interdependence.

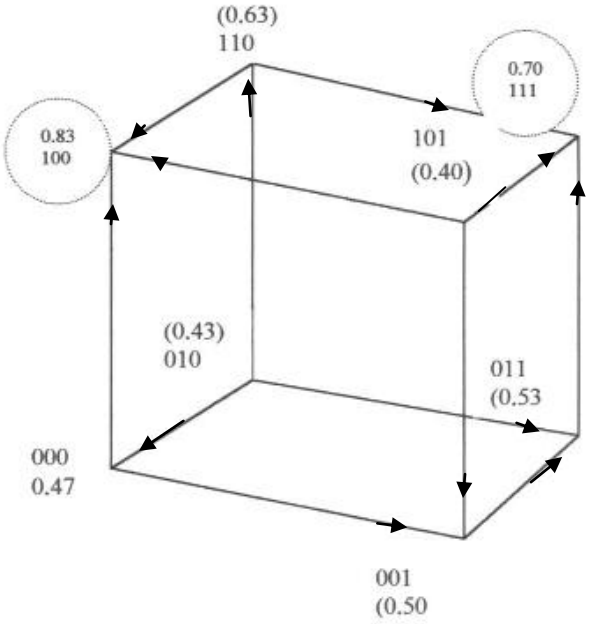
If K = 0, then each attribute is independent of the others and we have a smooth landscape where adjacent organisations do not differ very much from each other: At most they differ by 1/N. In contrast as K increases, the landscape becomes more rugged. A change in a single attribute effects the value of K other attributes. The maximum difference in fitness value between two such strings is (K+1)/N which means a rugged landscape with many local peaks and ravines. We owe this illustration of NK to Levinthal (1997). But the concept of correlated landscapes is based on findings in Spin Glasses and statistical mechanics.

As the interdependence in NK model is fundamental to the complexity of rugged landscapes we provide the following figures to illustrate it.

A



C



B

1 2 3	w_1	w_2	w_3	$w = \sum_{i=1}^{N} w_i$
000	0.6	0.3	0.5	0.47
001	0.1	0.5	0.9	0.50
010	0.4	0.8	0.1	0.43
011	0.3	0.5	0.8	0.53
100	0.9	0.9	0.7	0.83
101	0.7	0.2	0.3	0.40
110	0.6	0.7	0.6	0.63
111	0.7	0.9	0.5	0.70

Fig 2. Building a fitness Landscape. NK model of N = 3 genes each with 2 states (1, 0).

Each gene receives input from two other genes (K = 2). A- Two inputs are arbitrarily assigned to each gene. B- Each gene in each of the possible 23 = 8 possible genomes are randomly assigned a fitness contribution of 00 to 10. Then the fitness of each genome is computed as the mean value of the fitness contributions of the three genes. C- A fitness landscape is constructed. Circles are local optima.

Some Properties of Correlated Fitness Landscapes.

When K increases the complexity increase accordingly and the landscape becomes very rugged (K = N –1), so much so that it is called moonscape. At K = 0 we have Fujiyama. In this mountain there are no local search or local optima; everything directs to the high summit. A little like investing in the pre-crisis tiger economies. With low K we have a limited area of ruggedness which is good for local search. It is known as non-isotropic. This is like investing in certain areas of Eastern Europe where wages are particularly low. With K = N –1 local search for adaptation and search increases as do the number of local optima. The footpaths upwards are much reduced and the number of trials out of the location are much less. An adapting system is frozen into a very small region. With each step the number of directions dwindle by half. Additional improvements become very difficult. The situation is known as isotropic. Everywhere is more or less the same. Each hill becomes a mountain not much different from the big summit. This is like the EU. Interdependence is high, competition is severe, and profits are similar. This kind of landscape is rugged, dynamic, and almost of random space. It is an area of coevolution, that is, an area with mergers and alliances. The increasing interdependence and harmonisation in Europe can be attributed to conscious intergovernmental policies. In the world of evolutionary outlook these events can be viewed as sex on the rocks or in rugged landscapes. For ecologists (the

selectionist branch of evolutionary outlook), selection sets in when we are stuck in local optima (Carrol, 1988) is a typical ecologist. Others bring in long jumps and self-organisation to ameliorate the conflict. Referring to *diploidy*, Kauffman brings in sex as a way of smoothing the local adaptation. As an obviously experienced mountaineer, he marries two entities stuck in the rugged hills so that their offspring can see the way out! It seems that he vaguely attributes this to self-organisation, which he regards as a more superior tool to selection but at the same time as its complementary. Thus the same cooperative movement which can be seen as a Keynesian investment, is probably seen by self-organisers as FDI and strategic alliances. Sef-organisation is nature's way of learning. Some view it as a way of reaching global optimum, but others like Krugman express local and industrial interest with self-organized economies (Boldrin and Scheinkman, 1988). Kohonen's (1995) lateral adaptation may also be in this direction.

Long jump is the other way to solve the problem of being stuck in the local rocks. A large number of recombinations (mutations) alter the main features of an entity causing a long jump. With K around 5 we are still in the field of correlated landscape, but when it reaches 8 a long jump takes place. Once in a new field the search suddenly increases, which then levels out requiring another long jump. The number of jumps correspond to the logarithm of the commutative number of improvements. It takes 1000 tries to find the first 10 fitter variants, 1000 000 tries to find the next 10 and I billion to find the next 10. In the long run there is a tendency to average fitness. So at the end of the day all long jumps end up in a locality. The examples in technology are plenty. Look at the original bicycles. They had enormous back wheels and very small front wheels, or the other way round. Experiments were wild. But later experiments were like tinkering with little changes. In terms of investment, it is easy to see a similarity. Capital that

was once local moves into a new territory where it earns higher profits, feeds there for a while altering the landscape until the marginal income begins to dwindle. Some will continue with the long jump, and some will die locally. There is however a warning for overshooting though: If you jump far before absorbing the benefits of local search you may come a cropper. There are possibilities of rolling down to lower fields and the inevitable death. We can think of the inexperienced companies who jumped for higher profits in the Far East without learning the ropes and vanished. So there is an obvious learning process for international investment. Jumping over the local optima may look alluring but is replete with high risks.

Conclusions

The paper aimed to view foreign direct investment in the context of correlated rugged landscapes. It was hoped to find an alternative to the predominant FDI models that seem to underestimate locality. We thought the alternative to be the evolutionary outlook, particularly the way it is seen by Stuart Kauffman. We hoped to find these views more tolerant of locality. But in fact we find his views more inclined to globalism. He does not make any direct argument for locality. Nonetheless, he draws a realistic picture of the 'nature' of things in which cooperation replaces destruction.

Although Kauffman and others have been very conscious of the social and economic connotation of their analysis of Nature, they have mostly drawn their examples from technology development. Having studied FDI in depth, we made an attempt to open the way for further applications of evolutionary concepts to different forms of international investment. In FDI theories locality often means a country, but in large countries, regions and even townships can be brought into the evolutionary outlook to compare and test the waiting time before the long jump.

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