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EMERGING FINANCIAL CENTRES

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CONTENTS

Introduction

Theories of international trade consider financial services as so-called footloose industries. Since their existence does not depend on natural resources, in principle, they are not restricted in their choice of location. Nevertheless, those industries are not evenly spread over the world. Financial centres tend to concentrate asymmetrically in certain areas. Regionalism and "clustering" prevail. Today, London, New York and Tokyo are the dominant places in Europe, America and Asia surrounded by smaller ones. But, recently, their position is no longer unchallenged. In Europe, for example, Frankfurt and Paris invest heavily to strengthen their competitiveness in the wake of European Monetary Union, and in Asia, places like Singapore and Hong Kong have become a serious threat to Tokyo's leading role with others, such as Malaysia and Thailand standing in line to follow their example. These developments raise the question of how the emergence of international financial centres can be explained.

The following paper represents a very early stage of research. It will look at the role of evolutionary theories of spacial self-organisation in this context. Here, financial markets are considered as emergent systems which are characterised by a high degree of complexity. Under certain circumstances the interactions of many actors taken together - of individuals, firms and financial institutions as well as the administration and political authorities - are able to create a new quality or "culture" of a market place allowing it to become a truly international centre. Then, in principle, what needs to be explained is that process as well as the emergent quality. In this first study, which has a highly preliminary character, different possible approaches to this field will be analysed.

The paper is divided into five parts. Section I will desribe shortly the current situation in world financial markets. Section II gives an overview of the concept of economic geography and spacial self-organisation as it was introduced recently into economic theory by Paul Krugman and others. As a rule, for reasons of tractability those authors focus on very simple structures. Here, alternatives based on more elaborated concepts are searched for. The third section studies the possibilities to apply concepts of self-organisation and evolution to international financial markets asking how far the analogy to biological systems can be drawn. The fourth section will discuss the determinants of financial spacial concentration in greater detail and demonstrate what results can be expected from this kind of analysis. The fifth section will draw some preliminary conclusions.

1. CHANGING LANDSCAPES OF INTERNATIONAL FINANCIAL MARKETS

In recent years, there has been a tendency in the world economy towards greater regionalism. In international financial relations this has manifested itself in several ways. In the foreign exchange markets, the predominance of the US dollar has been slowly eroding and currencies such as the German mark and the Japanese yen, and to a growing extent smaller countries' currencies, play an increasing role in international transactions which is mainly explained by a higher share of trade in their respective regions (Table 1).

Table 1
Currency composition of gross foreign exchange market turnover[a]

Currency	April 1989	April 1992	April 1995
US dollar	90	82	83
D-mark	27	40	37
Japanese yen	27	23	24
Pound sterling	15	14	10
French franc	2	4	8
Swiss franc	10	9	7
Canadian dollar	1	3	3
Australian dollar	2	2	3
ECU	1	3	2
Other EMS currencies	3	9	13
Currencies of other reporting countries	3	3	2
Other currencies	19	8	8
All currencies	200	200	200

Source: Bank for International Settlements (1996a) Table F-3

Another indication of changing financial structures is the recent expansion of bank credit in some parts of the world. Bank credit to the private sector in some countries in Asia and Latin America has grown rapidly during the last years and, in particular in some Asian economies, is reaching heights in relation to GDP which are unparalleled in the industrial countries' latest history (Table 2). This contributed markedly to the strong expansion of the financial sector in these countries in general.

Table 2

Growth of bank credit to the private sector relative to the growth of GDP

	1981–89	1990–94	1995	1996[1]	Memorandum item: Bank credit to the private sector as a percentage of GDP	
	average annual percentage changes				1980	1995
China[2]	4.6	3.8	– 0.5	3.8	47.5	83.9
India	2.6	–2.0	3.8	– 2.0	20.2	23.9
Hong Kong[3]	11.7	8.8	8.9	– 6.1	71.7	321.4
Korea	3.2	2.6	2.2	– 0.6	36.2	55.7
Singapore	2.1	0.8	7.8	5.7	62.9	84.9
Taiwan	7.1	9.2	1.1	– 3.9	49.2	143.1
Indonesia	15.1	10.4	4.4	5.7	8.1	49.1
Malaysia	6.8	3.1	10.5	13.1	33.1	76.9
Philippines	–7.6	10.7	27.4	31.5	37.9	39.3
Thailand	6.8	10.0	11.1	5.8	27.5	88.7
Argentina	–4.0	7.9	6.2	0.4	16.5	17.9
Brazil	3.5	1.4	6.7	– 4.9	17.5	27.4
Chile	3.8	3.1	1.3	14.4	26.5	43.6
Colombia	2.0	4.1	4.2	5.0	10.8	16.4
Mexico	–1.9	25.7	– 0.6	–36.0	12.8	33.6
Peru	–9.6	22.0	25.8	29.9	9.2	12.7
Venezuela	–2.9	–9.6	–39.4	–19.6	24.9	7.0
Memorandum items:						
United States	*1.7*	*–3.5*	*4.2*	*– 0.6*	*62.1*	*63.3*
Japan	*3.8*	*0.3*	*0.5*	*– 1.9*	*81.0*	*115.1*
Germany	*1.4*	*2.5*	*0.8*	*4.6*	*74.2*	*96.1*
United Kingdom	*9.6*	*1.3*	*2.3*	*3.3*	*39.9*	*99.7*
Other G-10 Europe[4]	*1.7*	*2.0*	*– 2.6*	*– 0.8*	*61.0*	*76.2*

[1] Preliminary. [2] Credit other than to central government. [3] Total credit. Licensed banks only. [4] Weighted average based on 1990 GDP and PPP exchange rates. Table VI.6

Source: Bank for International Settlements (1996b), p. 108

Both high regional growth in the demand for finance as well as high ample liquidity worldwide in search of greater returns are the main reason for observed shifts in the ranking of stock markets worldwide (Table 3). Although data on market capitalisation are largely reflecting the ups and downs of share prices in the countries there are clear indications of an increasing role of smaller places at the expense of the big three, New York, Tokyo and London. Here, it is in particular the emerging markets in Asia which were constantly gaining grounds in recent years.

Competition between financial markets worldwide has generally strengthened. The smaller ones make considerable efforts either to win market shares by complementing the functions fulfilled by the big ones in one way or the other or by directly rivalling them, for example, by offering better facilities, services and conditions. The issue does not only involve private banks and financial institutions. Politicians around the world

have put it on their agenda to promote their own country's market place - so far with mixed results. While, for example, financial reform makes good progress in some European countries, the lifting of the Glass-Steagall restrictions in the United States is pursued only half-heartedly, and in some Asian countries the pace of financial deregulation is slowed down by recent turmoils in stock and currency markets and banking crises.

Table 3
Stock Market Capitalisation*

Country	Market capitalisation	
	1991	1993
1 United States (2)	2,324,646	5,223,768
2 Japan (1)	3,130,863	2,999,756
3 United Kingdom (3)	1,003,184	1,151,646
4 Germany (4)	393,453	463,476
5 France (5)	374,093	456,111
6 Hong Kong (14)	121,986	385,247
7 Canada (6)	266,874	326,524
8 Switzerland (7)	179,540	271,713
9 Malaysia (18)	58,627	220,328
10 South Africa (13)	123,981	217,110
11 Australia (11)	144,867	203,964
12 Mexico (15)	98,178	200,671
13 Taiwan (12)	124,864	195,198
14 Netherlands (8)	169,314	181,876
15 South Korea (16)	96,373	139,420
16 Italy (9)	154,126	136,153
17 Singapore (21)	47,637	132,742
18 Thailand (24)	35,815	130,510
19 Spain (10)	147,928	119,264
20 Sweden (23)	37,296	107,376

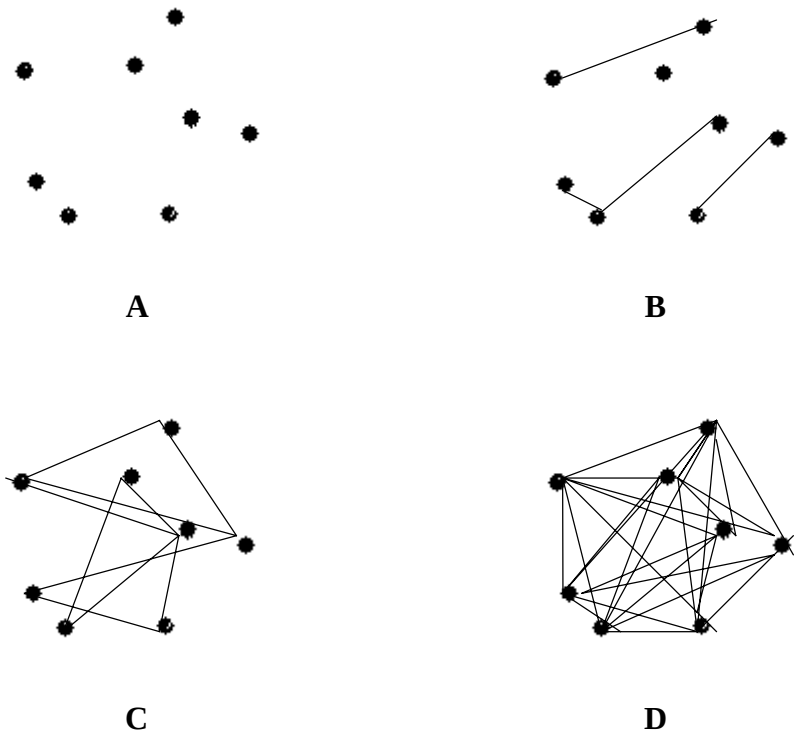
* In millions of US dollars, as end of 1993, in parantheses the country´s rank in 1991.
Source: The Economist (1994, 1996).

The question is what kind of financial structures will emerge from all these changes in the years to come. Will the traditional big centres manage to maintain, or even improve, their position? To what extent do smaller market places pose a serious threat to them? Will the ongoing "hollowing out" of the Tokyo market result in other places, at least in some market segments, taking the lead in the region? Will London's competitiveness suffice to cope with the future developments in Europe and ward off the ambitions of rivals from the continent?

The general question behind these considerations is how financial centres come into being and what determines their ability to keep a once reached supremacy. History shows that there is a considerable element of persistence and inertia in the rise and

decline of financial centres. From Amsterdam in the 17th century over London in the second half of the18th century and New York after World War I, and again in the postwar years, it took always great upheavals for a centre to lose its dominance.[1] However, this may not necessarily hold for the future. These days, international capital is by far more mobile, and investors' decisions are by far more volatile, than in former times which makes world financial markets much more vulnerable to changing attitudes. In addition, a broad interconnectedness of actors, in a sense, makes the places much more exposed to any form of herd behaviour with the possibility of small causes triggering large shifts in market sentiments and reactions.

Figure 1: Some patterns of connection of eight dots



While the influences of financial investment decisions are well explained by modern portfolio theory the motives behind the choice of a location and the rationale behind staying in one market place or shifting activities to another - let alone the processes behind the emergence and decline of financial centres in the aggregate - are widely unexplored. For economic theory the challenge here is to infer from the micromotives, actions and reactions of individuals to the macrobehaviour and inherent qualities of

markets.[2] Above all, this means dealing with complexity, with the ways in which the unorchestrated decisions of the many, whose individual actions can no longer be traced, of large "populations" showing statistical behaviour, lead to the emergence of order and structure on the system level.

In general, complexity describes a fundamental trait in the nature of things, of ideas, objects and relations, which can be defined in many different ways.[3] For example, there is computational complexity which can mean the shortest possible time a computer requires to solve a certain kind of problem. Or, there is the complexity of a pattern of connection which describes the ways in which points are connected with one another. In that case the criterion might be the length of description needed to characterise it. For instance, in this respect, D in Figure 1 where eight dots are all connected with one another might not be regarded more complex than A which has no connections.[4] There is a measure called "crude complexity" standing for length of the shortest possible message describing a system. Someone writing a story of a neighbour whose house is burning yelling: "Fire! Fire!" and then repeating the word "fire" 298 times over the next pages, could perhaps write instead: "´Fire!´ 300 times" without loss of information.[5] The concept of crude complexity closely resembles that of Algorithmic Information Content (AIC) which refers to computer programs considering a particular message string and asking, under well-defined circumstances, which is the shortest program causing a computer to print out that string and then stop computing.

All definitions of complexity are context-dependent, that is, in all cases, information is needed about the level of detail and about how coarse-grained the analysis is intended to become. For example, in the case of financial markets, a decision has to be made whether the interaction of business decisions, of individuals or of certain groups of actors such as banks, institutional investors, security houses and the like are to be studied.

In biology as well as in many other disciplines, complexity is often seen as the key to understand evolutionary processes and the phenomenon of emergence. The composition of objects and beings, the interplay of their elements and components, the number and depth of relations and interactions are all understood to make a system "evolve" over time in its adaption to a changing environment. In their interplay they are adding a new quality to the system making the whole become, in a sense, more than the sum of its parts, to cite an often given definition of emergence. What does this mean for economic relations in general, and for financial systems in particular? In the field of economics,

complexity is usually understood as a characteristic of the interplay in which the motives and reactions of individuals, housholds and firms create structure and coherent stable and orderly behaviour in the aggregate. How can such a system be analysed? In what follows, one attempt to model and explain the spacial self-organisation of an economy will be presented which may give first hints to the answer.

2. SPACIAL SELF-ORGANISATION

In general, economists in an Anglo-Saxon tradition concentrate on explaining changes of economic variables over time. The question how an economy organises its use of space has long been neglected by the majority of them.[6] Location theory, as it is called, is a side issue which has its roots in Germany, in the works of von Thünen, Christaller, Lösch and others.[7] In the 19th century, Johann Heinrich von Thünen first analysed the problem how land around an isolated town supplied by farmers should be allocated for given yields and transportation and production costs taking into account different crops and different intensities of cultivation. He found that if farmers compete for the land, under certain assumptions, the result is the emergence of concentric rings of production for each crop around the town.

More than a hundred years later Walter Christaller and August Lösch developed their theory of central places. In short, the starting point is again a community of farmers. They are assumed to be in need of some activities, such as manufacturing or administration, which due to economies of scale cannot be spread evenly among them but have to be provided centrally. There is a tradeoff between scale economies and transportation costs which eventually leads to the emergence of a lattice of central places each surrounded by farmers relying on them. Those places form a hierarchy: A number of market towns "cluster" around a larger administrative centre which in turn is forming a clump together with others around one place, and so on.

In principle, those early theories could also be applied to business districts within a metropolitan area or any other phenomenon of spacial agglomeration or "clustering". Their common feature is an emphasis of opposite forces, of attracting effects (i.e. economies of scale) and repellent influences (transportation costs), determining location and the emergence of structure in an otherwise featureless plain. The importance of diametrically opposed forces for determining locational decisions is also emphasised in one of the latest efforts to explain spacial concentration, the edge city model proposed by Paul Krugman.[8]

Krugman criticises the early location theories on the grounds that they do not capture the process by which individuals or firms interact, and centralisation takes place, and that they do not explicitly deal with complexity and the mechanisms through which macrobehaviour emerges from micromotives. His edge city model aims at shedding some light on the process of how decisions of businesses about where to locate are formed.

Along the lines of modern urban economic theory the model starts from the assumption of a long narrow city which, in fact, is one-dimensional and located on a circle[9] with movement only possible along its circumference. To keep the model as sparse as possible there is no land rent and land scarcity is thought of as, in a sense, included only in an implicit reduced-form way. For the same reason, there is no forward-looking behaviour. In addition, although the conceptual weaknesses of the approach are acknowledged, external economies are assumed. These drastic simplifications are considered as necessary to explain the basic idea as clear as possible.

This basic idea is a most rudimentary form of spacial concentration. Locational decisions are determined by two kinds of "forces", a centrifugal and a centripetal one. The decision of each firm where to locate is depending on all other firms´ choices. The two kinds of forces are determined by different interdependencies. On the one hand, firms are assumed to dislike having other businesses nearby because they compete for customers, workers and land. These motives are called centrifugal forces. On the other hand, to have other businesses close has advantages. For example, they attract customers to the area or add to the variety of local services offered. These considerations are interpreted as centripetal forces that attract businesses and make them locate in "clumps".

The interaction of centripetal and centrifugal forces determines the process of businesses migrating from less to more desirable sites over time. In order to end up in polycentric patterns and "clustering" which were to be modelled two criteria must be met: The first is the existence of a tension between the two kinds of forces with neither being too strong. The second requirement is that the range of the centripetal forces must be shorter than that of the centrifugal ones. The central equation of the model looks as follows:

$$P(x) = \int_z \left[A\exp(-r_1 D_{xz}) - B\exp(-r_2 D_{xz}) \right] \lambda(z) dz .$$

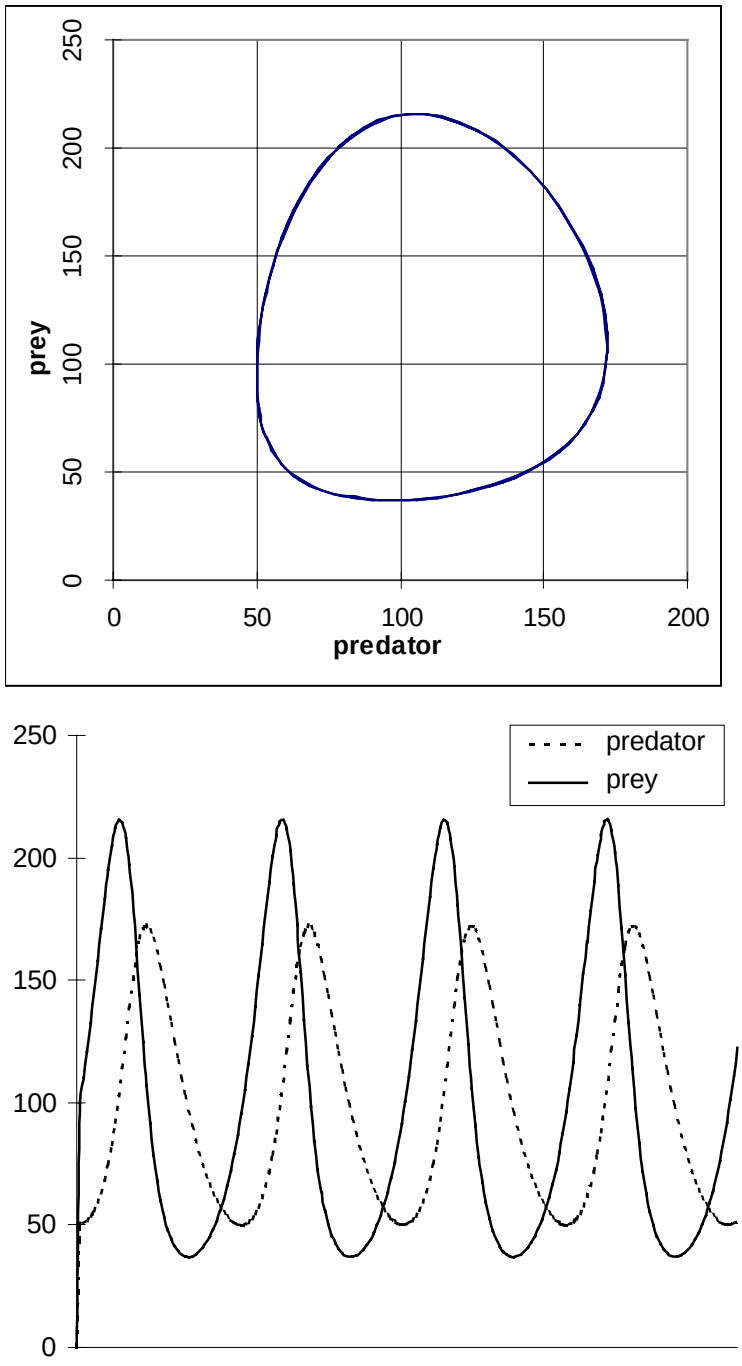
Here, x is some location on the circle and $\lambda(x)$ is the density of firms at that location. P denotes the "desirability" of location x which is also called the location's *market potential*. It depends both positively and negatively on the density of firms at other locations with the strength of attracting and repellent forces named A (for the centripetal) and B (for the centrifugal) and r_1 and r_2 are standing for the rates at which these forces dissipate with distance. D_{xz} measures the distance between two locations x and z.

What is striking to an outside observer at first sight is the regularity of Krugman's simulation results. With the number of sites eventually coming out depending on the parameters chosen, there are equal distances between all locations with every two of them exactly opposite one another on the circle.[10] The dynamics described here closely resemble to the forces of "stretching" and "folding" found in many nonlinear models of time series which had been developed to describe periodic or quasi-periodic behaviour in disciplines as diverse as physics, chemistry, sociology and biology.

Since the analogy is obvious, one of the simplest models of nonlinear interactions in biology, the Lotka-Volterra model of predator-prey behaviour may serve to illustrate the mechanisms at work. The model starts from a population of prey which is limited by the available food and which, in addition, can be reduced by predation. The population of predators feeding on the prey is limited by the number of the latter.[11] In the beginning, the population of predadors is small, they find plenty of prey and their reproduction is largely unhindered. But with increasing number the prey population gets depleted and soon will no longer suffice for all. Fewer and fewer predators will survive. This, in turn, allows the prey population to reproduce faster again and the cycle is ready to repeat.

The interplay between the ups and downs of both groups can produce quite different outcomes. Depending on the length of both cycles fixed points, periodic or quasi-periodic developments are possible. In Figure 2 the cycles of growth in both populations shown in the lower half result in a limit-cycle, representing a quasi-periodic system behaviour where nearly all trajectories or paths outside are ending up in an almost regular motion of growing and shrinking.

Figure 2: Predator-prey dynamics



Source: Fleischhauer (1998).

Paul Krugman is not the only one drawing an analogy to this kind of models of biological systems in time. Another author modelling spacial economics who is explicitly referring to the Lotka-Volterra dynamics is Dimitrios Dendrinos. In his analysis of "urban macroeconomis" urban areas as well as industrial sectors, regions or nations are competing for development in space-time, as he calls it, and "for a position

or niche in their respective spatio-sectoral hierarchies."[12] Again, there is a variety of diametrically opposed forces, which are reduced to two sorts. They are represented by urban population and per-capita income which are considered as functions of all others.

The periodic patterns produced by models of developments over time, such as the predator-prey dynamics, have their correspondents in the polycentric patterns of Krugman´s edge-city model evolving in space.The question is what is won by drawing this analogy of "spacial periodicity" to biological rythms and patterns. One mentioned advantage is the exposition of the basic idea as clearly as possible. However, once the effects of stretching and folding, of the interplay of repellent and attracting forces is understood, very few additional insights can be gained.

In an earlier work,[13] Krugman derived the centripetal and centrifugal forces in the economy he had in mind from microfoundations based on a model of monopolistic competition in an attempt to clarify the economic mechanisms behind. Monopolistic competition is a highly artificial situation characterised by the following assumptions.[14] There are many products and firms with each firm solely producing its own brand. Being aware of its monopoly power it sets the price of its product. The number of firms and products is too large for strategic interaction to play any role in the aggregate economy. Market entry is unrestricted and takes place until the profits of firms in the market are driven down to zero.

Monopolistic competition is considered very useful for modelling aggregate phenomena without referring to strategic interactions. Firms are not forward-looking and trying to anticipate others' decisions but merely react to the others´ past choices by adjusting their own location respectively. The centripetal and centrifugal forces behind their decisions are explained, for example, by agglomeration benefits from increasing returns to scale and transportation costs.

In simulations of such a model Krugman found the same kind of regularities as for the simple reduced-form version described above.[15] These regularities point at a major weakness of the approach, at least for the object pursued here: The symmetries stand in strong contrast to the patterns evolving in the real word where "ruggedness" and asymmetric clustering prevail. The reason lies in the underlying mathematics: Closed conservative systems such as the Lotka-Volterra model are not able to produce the patterns of interaction which lead to the dispersed asymmetric long-term invariants or

structures one is looking for when confronted with complex systems, self-organisation and emergent phenomena.[16]

The model of monopolistic competition is able to explain spacial concentration in the sense of mere increase. But it describes the move towards an equilibrium state and not the evolution of an emergent system. In contrast to what is claimed, the repellent and attracting forces in the Krugman world are not emergent properties.[17] They contribute to accumulation and growth of a location. But, at every moment, they are fully attributable to the firms' behaviour. There are not really the many interacting units in this model, the large populations showing statistical behaviour, whose interplay adds a new quality to the system which is fundamentally changing its nature in the adaption process. In Krugman's world, Schenectady, New York, does not differ fundamentally in its quality as a central place from New York City.[18]

However, it is exactly this "organic" change in nature which is thought crucial here for the transition of a financial market place to become an international centre. Banks deciding to establish their business in the same location do not constitute a centre in this sense. There are many markets and places in the world fulfilling many functions and offering many kinds of the services that can be found in London or New York as well. And many of the banks in London and New York have businesses elsewhere, in principle, engaged in the same kinds of activities. On the other hand, obviously it is not only the size of markets which matters, at least this is what many market participants and others concerned seem to think. Otherwise, smaller places such as Hong Kong and Singapore would not show so much enthusiasm in their efforts to compete with the big ones.

What makes the difference is that with the growth of a market and increasing complexity sometimes a kind of a *self-organized criticality*[19] is reached after which the place is not the same as before. Slowly and perhaps imperceptibly an adaption process to the needs and demands of internationally active participants in the market has taken place meeting more and more the criteria of an international financial centre, respective facilities have grown, norms, rules of conduct and attitudes and behaviour patterns have become established and the administrative and political scene has subtly adjusted to the changing environment. Now, the time is ripe for storming the ranks and competing for a larger share of international business. Can this process be influenced from outside? If the financial market is a truly emergent system the possibilities are limited. There are certain preconditions which must be met and which can be designed as favourable as

possible, but, in the end, whether the odds are in favour of the place or against it is decided by circumstances, or by what evolutionary theorists would call historical accident.

Traditional equilibrium models in economics can be subsumed under a view Brian Arthur, one of the pioneers of the new science of complexity in economics, calls *stasis*. He contrasts it to a second one which sees spatial order as process-dependent "with new industry laid down layer by layer upon inherited."[20] Under *historical dependence*, as he calls this latter view, the system determining locations is fundamentally dynamic and structure is created far from equilibrium. It does not settle down in a state, or on a path, where nothing is ever changing again. Arthur emphasises two distinct characteristics. A process- or path-dependent system is nonergodic which means a statistical property saying that it can follow divergent paths whose realisations measured as averages from data samples, in a probabilistic sense, converge over time to spacial ensemble averages.[21] Further, the system possesses a multiplicity of outcomes which makes it inherently nonpredictable.

While under the *stasis* view location should be completely explained by agglomeration economies, transportation costs and the like, proponents of historical dependence largely consider the eventual choice of location as the outcome of chance, of historical accident. The economic environment, and the changes it undergoes every day, present an unlimited number of possibilities. Chance determines the path which eventually will be taken. Then, what needs to be explained is not only this environment, but how chance is working and selection taking place, and how history is picking the winners among the many possible states. Present research in this direction is still in its infancy with concrete lines of argument from a highly theoretical level to actual inferences widely rudimentary. Nevertheless, with its emphasis on evolutionary processes far from equilibrium this direction appears one of the most promising to account for the rise and decline, and for observed asymmetries, in the evolution of financial centres.

3. EVOLUTIONARY THEORIES

Nowadays, there is a wide variety of evolutionary theories searching explanations for all kinds of social and economic change. Most of them share several characteristics which constitute a kind of common basis.[22] For example, there is the already mentioned emphasis of dynamics. None of those concepts is interested in simply explaining something being but is asking how it became what it is. Theories are explicitly microfounded. There is no "macrobehaviour" without "micromotives". And, in a very

broad sense, rationality is "bounded". Agents are assumed to have at best an imperfect understanding of their environment. Learning is imperfect and path-dependent. One direct consequence is persistent heterogeneity among agents. Their collective interactions far from equilibrium determine the system's path, i.e. the regularities or irregularities shown as emergent properties in the aggregate.

There are two phenomena to be mentioned in this context. One is phase transition as a characteristic of evolutionary processes. A system which, in the beginning, is simple and predictable is going through sequences of qualitative transitions ending on a wholly different path of irregular motion. The second is lock-in. A system which has once reached a particular state sometimes requires considerable efforts or energies to overcome it, even if it proves suboptimal in the eyes of an outside observer.[23] While the possibility of the former is rarely considered among economists the validity of the latter as an explanation of economic states and processes is hotly debated. In location theory, the question centres around the existence of external economies and increasing returns of scale.

The assumption of external economies is somehow, to cite Paul Krugman again, like explaining the fact that firms agglomerate with agglomeration economies.[24] Opponents of the idea claim that in most cases external economies can be internalised by taking into account scale economies, transportation costs and the like. For the spacial organisation of financial centres this point is of special importance. Considering the footlose nature of the financial industry where many traditional explanations for agglomeration do not hold increasing returns appear a particular attractive argument for "clustering".

Lock-in stands for a kind of inflexibility in the evolution of a path-dependent system resulting in a suboptimal or locally (instead of globally) optimal outcome which is self-reinforcing. Sometimes, a parallel is drawn to phase-locking and the difficulties of exit in nonlinear physical systems.[25] The phenomenon results from activities which have an increase in payoffs the more they are undertaken. In these cases, due to the lead in profitability, of several possible alternatives the one which is chosen first will continue to be chosen thereafter.[26] The most widely known example is the QWERTY keybord. QWERTY refers to the ordering of letters on a (American) typewriter which originally was said to be designed to slow down typing speed to keep old-fashioned mechanisms from jamming. Nowadays, the keybord is claimed to be far inferior to alternative

solutions, but once introduced on a broad scale, allegedly no producer found it profitable to switch to another keybord. QWERTY was "locked in".[27]

In an analogy to the natural sciences it would be interesting to search for indications whether financial markets´ development showed signs of lock-in in the past. However, there are serious warnings to draw this analogy at all.[28] These warnings say that evolutionary theory is

"a remarkably inappropriate model, metaphor, inspiration, or theoretical framework for economic theory. The theory of natural selection shares few of its strength and most of its weaknesses with neoclassical theory, and provides no help in any attempt to frame more powerful alternatives to that theory."[29]

Earnest research cannot easily shrug off this critique. Therefore, it seems worth having a closer look at possible common traits and differences for the subject discussed here.

In general, evolutionary theories consider three factors as decisive for evolution. Those are mutation, natural selection and chance. Mutation provides the material, i.e. the genetic difference, on which natural selection acts. As one famous geneticist puts it: mutation proposes but selection decides.[30] Natural selection enables a system or an organism to adapt to its environment driving it toward fitness maximisation and reproductive success. Chance comes in in several ways. On the one hand, there is a statististical effect known as genetic drift.[31] The carrier of a mutation may die without passing the mutation on to subsequent generations. Or, in contrast, the mutation may be spreading widely due to casual events. On the other hand, mutation itself occurs randomly. Chance makes evolution not just the survival of the fittest but also the survival of the luckiest.

It is the natural selection part of evolution which by the critics is considered to impose the most hindrances to an application of the concept in economics.[32] The minimal condition for evolution by natural selection is that there are *replicators* and *interactors*. A replicator passes on its structure intact in successive replications. Genes are, and organisms can be,[33] replicators. Interactors are by their very name entities that "interact as a cohesive whole with their environment in such a way that this interaction causes replication to be differential."[34] This can be organisms, but also cells, genes, tissues, organs and the like.

Another useful term in evolutionary theories is *lineage* standing for the entity which actually evolves. In general, lineage is defined as the line of decent which can be traced from a common ancestor. Interactors are composed of lines of descent and some proportion of types of interactors in the cohesive whole is changing from generation to generation. In order to demonstrate the meaning of the different terms, the analogy can be tried on an example from economics. A firm which is switching to more adapted rountines is developing, growing in size and increasing its profitability. But, for evolution to take place at the firm level, it must become its own descendant, otherwise the analogy breaks down. According to evolutionary theory, changes within one member of the lineage do not count as evolution. They are simply a matter of development. The improved adaption has to be passed on to descendants, successors, subsidiaries or the like.

Figure 3 illustrates the difference: A is an example of evolution. There are three generations of a population with each line representing an individual organism. The composition of the population changes in each generation with the share of those changing from property a to a´ constantly growing. In contrast, in B, a and a´represent individual development over time, for example, from birth to death, but the composition of the population has not changed between generations.

Critics often do not mind drawing the analogy between economic processes and evolution in principle, but take offence of actual applications found in the literature. Most of them would probably not deny that what natural selection is to nature and living conditions in their widest possible sense, *cultural selection*[35] can be to human communities and social systems. Here like there, innovations brought about by "mutation" are checked and tried and either adopted or rejected. Although a precise definition may become difficult, the mutations cultural selection is acting on can be regarded as the innovations and inventions cultural parents pass on to the next generations with cultural fitness represented by a measure of the degree of influence exerted.[36] Therefore, it seems less the analogy per se but the careless usage of terms and concepts which is criticised.

4. EVOLVING FINANCIAL CENTRES

One immediate conclusion from the preceding remarks is that each sensible analysis of an evolutionary economic system has to find an answer to the following questions:

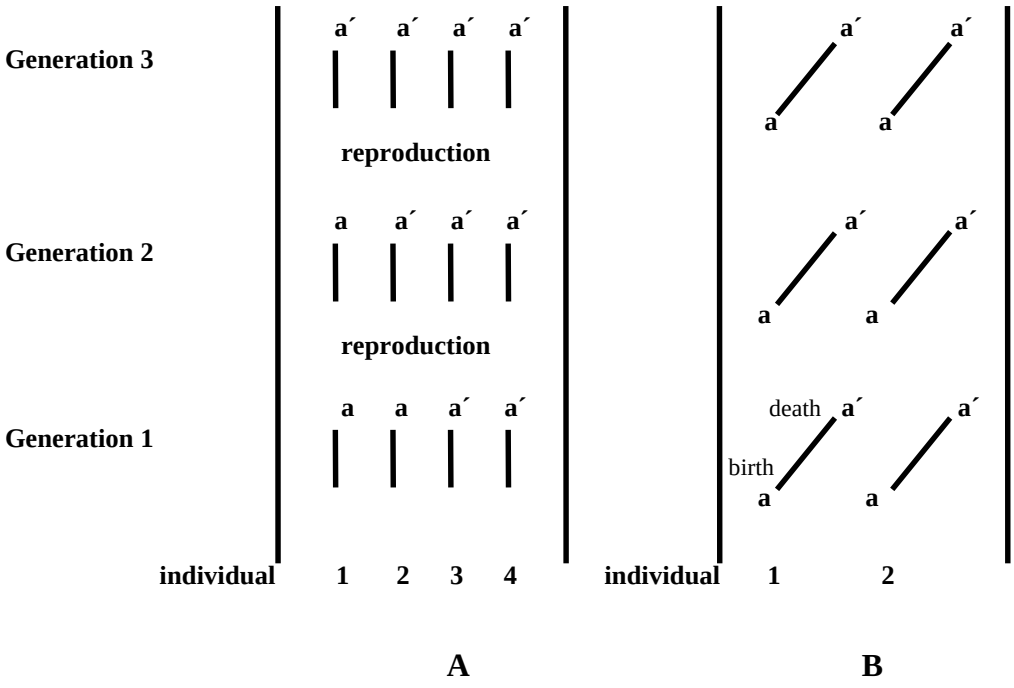
- What is it that is evolving?

- What is the lineage?
- What are the generations?
- Which are the replicators?
- Which are the interactors?
- What is the measure of fitness?

The answer to some of these questions had been suggested earlier. The evolving entity in the analysis intended here is the international financial system consisting of various centres and subcentres of international financial activity as well as other bank places at the periphery. The interactors in this system are individuals and firms but also markets and market segments as well as institutions and other entities developing the "rules of the game" in a market place. Those rules may consist of laws and regulations but may include norms, conventions and behaviour patterns passed on from generation to generation of actors as well.

In this framework, the replicators which pass on their structures intact in successive replications may be thought of, not as the banks and financial institutions and other actors themselves, but as the inherited characteristics, laws, rules of conduct and long-term behaviour patterns those actors develop over time, and over generations, which eventually make up for the market "culture". What is reproduced again and again, constantly adapting to the environment, are the interacting components of this culture which allows the place to survive.

Figure 3: Evolution and development



Source: Ridley (1996), Figure 1.1.

In each centre, and in each place at the periphery of financial developments, there are countless people every day making decisions and acting on their own behalf as well as on behalf of their firms and institutions within the limits of set rules, norms and conventions. In interacting their abilities, motives and behaviours within a given environment, and in reaction to changes in this environment, determine the evolution of a centre's special characteristics, its comparative advantages and disadvantages, and its role within the international financial system. The locus of selection is the individuum, the emerging outcome is on the macro level. The populations in question are large enough to show statistical behaviour and regularities (or irregulatities) in response to environmental changes. Firms may grow or decline, they may merge or divide, establish subsidiaries, or change their business focus, the culture of the market place, and its reproduction success, which is determined by the interactions of the many and their influence in the aggregate is largely unaffected by this.

Each financial centre is distinct from another and from any other market place in the world. What determines its market culture´s competitiveness or complementarity and its ability to survive? One could think of several measures of "fitness" in this context. One might be a place´s share, regional or worldwide, in particular market segments such as

stocks or derivatives trading. Another could be the range of financial instruments available or the number of foreign institutions present at that place.

The processes one is looking for in such an analysis are very long-term by nature. However, this does not exclude the possibility of phase transitions and sudden jumps. The question is under which circumstances these processes may become self-reinforcing, what kind of dynamics can be expected to evolve and to which extent conclusions about the resulting path can be drawn. One fundamental issue here is the degree of abstraction chosen. Above all, this requires that a decision has to be made for or against a formal model as tool of analysis.

There is one simple reason why economists prefer models which, at times, is frankly admitted as in the following citation, which is again from Paul Krugman: "...it seems to me that an economic idea flourishes best if it is expressed in a rather technical way, even if the technical difficulty is largely spurious. After all, a teacher wants something to do at the blackboard, and a clever student wants something on which to demonstrate his or her cleverness. If a deep idea is conveyed with simple examples and elegant parables, rather than with hard math, it tends to get ignored."[37]

The danger of this view, and of formalisation as a goal per se, is that in making highly unrealistic assumptions any serious effort to understand processes which are not easily formalised, and which would not lead to concrete numerical results in empirical estimations and forecasts at a later stage, is undermined. This holds in particular for emergent, path-dependent economic systems far from equilibrium.[38] For those systems, any formalisation may be helpful in structuring and clarifying basic ideas. Beyond this, its use is highly doubtful and deeply misleading. Even the very trial to structure basic ideas in a formal way may lead to serious misinterpretations of the nature of underlying relations and processes driving the whole enterprise ad absurdum. Krugman's edge city model in its total misread of the nature of self-organising processes and their relevance for firms' location is one example, but, in principle, this danger exists for all kinds of path-dependent economic dynamics. Without exactly knowing the underlying laws of motion and initial conditions in these cases no statement about a system's behaviour, and about the ways in which influences from outside are acting on it, is possible. In particular for economic dynamics one must admit that "no analytical and empirical foundation supports any particular equations of macrodynamic motion."[39] This fact, which holds for financial markets as well as for any other economic system, strongly

limits the analogy that can be drawn between biological evolution and economics reducing the role of evolutionary theory to that of an, albeit useful, metaphor.[40]

Then, which are the analytical tools by which insights in the spacial self-organisation of financial markets and a deeper understanding of the underlying processes might be gained? The answer is classification and historical analysis. One of the few certainties research on path-dependent self-organising systems has produced is the importance of the existence of diametrically opposed forces, of "stretching and folding", comparable to those factors which, although with another kind of mechanisms at work in mind, had already been emphasised by early location theories. Thus, a useful starting point for research on the emergence of international financial centres might be to look at history asking how markets evolved in the past and which where the main determinants of their rise and decline. Then, at a second stage, a more general classification of the attracting and repellent influences in the process of evolution is needed could be developed based on the results.

For classification purposes, several further distinctions giving additional insights can be made. First, evolution stresses the importance of long-term persistence. Adaption is not immediate. It requires the environment to remain relatively constant over long periods of time. This suggests a distinction between short- and long-term influences, between "climate" and "weather" to use a metaphor from the natural sciences once again, as well as between locally and globally acting forces. However, one should bear in mind that under path dependence this distinction is easily becoming meaningless since in these cases, small, transient causes may result in large differences in outcomes. Then, the challenge will be to further distinguish between scenarios of regular and irregular system behaviour, and the transition between the two, and to analyse the possibilities to discriminate between them outlining the conditions prevailing in each case.

Another distinction follows from the fact that, as mentioned in the beginning, some financial markets are trying to build up facilities and services complementary to those in other places while others are directly competing in the same areas. Thus, distinguishing between competitive or complementary influences seems another useful criterion. A final distinction concerns the role of policy and the influence it might exert on the relative performance of markets. A broad classification should identify those factors which affected by policy measures and others which are not. The last stage of research would be to apply these findings to an analysis of actual markets coming to an evaluation of their current state as well as future prospects.

5. CONCLUSIONS

As emphasised in the beginning, the considerations presented here are very preliminary by nature. Nevertheless, some of the aspects discussed seem worth summarising. First, financial markets worldwide show a tendency of asymmetric regional " clustering" with newly emerging places challenging the dominant position of the traditional centres. The question is if and to what extent these developments can be explained by processes of spacial self-organisation and evolution. It has been argued that an insufficient analytical and empirical foundation forbids drawing the analogy to the natural sciences too far and the prerequisites for theorising about those processes had been outlined.

Financial markets can be regarded as emergent, self-organising systems. They are characterised by a high degree of complexity and a large "population" of actors, whose individual behaviour and strategies can no longer be traced but whose interactions result in the emergence of order and structure on the system level. They are able to create a market "culture" which allows a place to become an international centre. For this culture to emerge, and for banks and other institutions from all over the world to locate in this place, several conditions have to be met. Theories of self-organisation emphasise the existence of repellent and attracting forces which must come together in a certain way for emergent qualities in the aggregate to evolve. The main challenge for further research will be to identify those factors, to explain the ways in which they influence the rise and decline of markets and to exploit the scope for policy action.

Self-organising economic systems may not allow building models as design for "basic ideas" or to forecast the future. But, they may offer rich insights to those studying them in detail. So far, little research on the determinants of the location of international financial activities has been done, and the influences and mechanisms behind the rise and fall of markets are poorly understood. Given the present dramatic changes in the world financial system, every attempt to enhance the understanding of its functioning seems worth the effort.

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Notes

1 A detailed overview of the history of financial centres gives, for example, Einzig (1970).

2 Micromotives and Macrobehavior is the title of a book by Thomas Schelling which gained some attention in the context of modelling the self-organisation of markets and economies recently. See, for example, Krugman (1996), and for the reference Schelling (1978) .

3 See for the following Gell-Mann (1994), pp. 28-41.

4 This and the next example are taken from Gell-Mann (1994).

5 Of course, whether in this example the message still has the same information content depends both on the intention of the writer and on the reader´s understanding.

6 Compare Krugman (1996), p. 9.

7 Von Thünen (1842), Christaller (1932) and Lösch (1944). The following relies heavily on Krugman (1996).

8 See for the following Krugman (1996), pp. 22-29.

9 The assumptions about the nature of the urban area in this context are:
- The city has a single centre of fixed size, the central business district (CBD) in which all job opportunities are located;
- There is a dense radial transport system, free of congestion, with travel consisting only of workers commuting between residences and CBD;
- The land is featureless plain, all land parcels are identical and ready for residential use. There are no local public goods and no neighbourhood externalities.
Under these assumptions, the only spacial feature of each location that matters is distance from the CBD which justifies a one-dimensional treatment. See also Fujita (1989), p. 12.

10 Compare Krugman (1996), pp. 25-27.

11 Ian Stewart speaks of sharks and shrimps to illustrate the model. See Stewart (1989), pp. 264-266.

12 Dendrinos (1992), p. 110.

13 Krugman (1991).

14 See for the following and for a general overview of the main directions of this strand of research in economics Matsuyama (1995).

15 See Krugman (1991, 1996, pp. 106-115).

16 See for a brief general comparison of the properties of conservative and dissipative dynamic systems with an application to the foreign exchange markets Reszat (1992).

17 As said earlier, emergence refers to a quality added to the sytem which is not inherent in its parts. For example, for Stuart Kauffman "life" is an emergent whole of biological systems which is not located in the property of any single molecule. Compare Kauffman (1995), p. 24.

18 There is a conceptual misunderstanding which Krugman is sharing with many traditional economists. See, for example, Mirowski (1990), Bausor (1994).

19 This term which was coined by Per Bak originally described a type of macroscopic instability in condensed-matter physics. An application to the economics of production and inventory dynamics can be found in Scheinkman and Woodford (1994).

20 Arthur (1994a), p. 50.

21 Those spacial ensemble averages are named strange attractors in phase space. See for a brief description of the concept of ergodicity De Grauwe et al. (1993), p. 53.

22 The following is by far no exhaustive list of common characteristics. Compare also Dosi (1997).

23 Strictly speaking, under path dependence the criterion of "optimality" does not make much sense. In this case, it is no longer possible to trace the comparative performance of various alternatives under given conditions on average since slightest changes in these conditions, which cannot be ruled out, may

fundamentally alter the results. Optimality here can only refer to a best-possible adaption of the individuum taken all influences of the environment into account and, thus, is highly circumstantial.

24 Krugman (1996), p. 23.

25 Compare Arthur (1994b), p. 115-119.

26 Arthur (1994b), p. 116.

27 Some writers simply doubt this story, for which much counterevidence can be found, and argue that the theories of path dependence have no empirical support whatsoever. See, for example, Liebowitz and Margolis (1997).

28 See for the following the very lucid reasoning of Rosenberg (1994).

29 Rosenberg (1994), p. 384.

30 Cavalli-Sforza and Cavalli-Sforza (1995), p. 102.

31 Compare Cavalli-Sforza and Cavalli-Sforza (1995), pp. 97-100.

32 The following relies heavily on Rosenberg (1994). See for a most stimulating confrontation of the possible contributions of evolutionary theories to the explanation of economic phenomena with those of other concepts from psychology and game theory Selten (1991).

33 This is the case if organisms and their offspring have more or less the same structure. The problem sometimes arising is how to identify a distinct offspring whose structure can be compared. See Rosenberg (1994), p. 403.

34 Rosenberg (1994), p. 403.

35 The term was coined by Cavalli-Sforza. See Cavalli-Sforza and Cavalli-Sforza (1995), pp. 192-193, and for some critical remarks concerning its use Selten (1991).

36 Selten (1991), p. 12.

37 Krugman (1996), p. 16.

38 For example, this critique, too, applies to modern theories of the New Growth Theory in their inability to adequately take into account actors´ imperfect understanding of the path of development. See for the critique in detail Nelson (1997).

39 Bausor (1994), p. 121.

40 Since Donald McCloskey published his book on *The Rhetorik of Economics* the way how metaphors are used by economists and their justification has found a renewed interest. See McCloskey (1985). A very lucid discussion of the role of metaphor in scientific discourse in general can be found in Bicchieri (1988).