ECONOMIC THEORY AND TECHNOLOGY HISTORICAL PERSPECTIVES

ADAM SMITH: in his book titled, An Inquiry into the Nature and Causes of the Wealth of Nations (1776) indicates clearly that he wanted to analyze the nature of economic growth. Smith attributes growth to the skill, quickness and judgment with which its labour is generally applied. The major themes are **economic growth, value and distribution, the working of markets, intern trade and the relationship** between the state and the individual.

Although Adam Smith wrote within the context of a primarily agrarian society, he was profoundly aware of the importance of **machinery.** In his Wealth of Nations, Smith attributes increases in labour productivity to three major causes, the last being **the invention of machinery**. In casual terms, Smith saw the development machinery as the consequence of the social division of labour in the factory, thus implicitly taking issue with latter-day technological determinists who examine the effects on economic and society of autonomous as in technology, including machinery.

Smith states clearly that "the invention of all those machines by which labour is so much facilitated and abridged seems to have been originally owing to the division of labour. However, in elaborating on the link between social division of labour and the development of machinery, Smith with great foresight, anticipated the emergence of a specialized **capital goods sector and the application of the division of labour to science itself,** although the pointed out that, "common workmen" often invented or improved the relatively simple machinery that enlisted in his day.

Being the mastered observer that he was, Adam Smith was also acutely aware of commutative importance of **incremental as** in the improvement of machinery, a perception that was later to be observed by the emphasis given to major technological as in the writings of author Schumpeter. Smith noted that **"we have not, nor cannot have, any complete history of the inventors of machines,** because most of them are at first imperfect and receive gradual improvement and increase of powers from those who use them".

DAVID RICARDO: Writing at a time when the industrial revolution was well underway, machinery (or, more generally fixed capital) was more central for Ricardo than for Adam Smith since in his model. Ricardo assumed that **all accumulation was derived from profit,** the question of the distribution of the national product between profit, rent and wages, assumed a central significance. In examining the relationship between profit, rent and wages, Ricardo abstracted from international trade and technical change. Ricardo argued that the result in an increase in the marginal cost of food as diminishing returns in agric sets in and less fertile land was cultivated. This intern resulted in an increase in the share of wages and consequently in a fall in the share of profit. Eventually the point would be reached where total W = TP – R, and with profit reduced to zero, the stationery Ricardo's work.

For Ricardo, technical change embodied in machinery would increase the rate of accumulation by reducing the cost of wage goods. "if … by the extension of foreign trade or by improvement of machinery, the food and necessaries of the labour can be brought to the market at reduced prices, profit will rise". Therefore, technical change exerts a positive influence, not directly on output, but through effects on wage and accordingly profit.

Ricardo was also interested in the direct consequences for the working class of the introduction of machinery and shocked many of his contemporary when he declared, in a new section in the edition of his principles published in 1821, that new machinery might be injuries to workers by

reducing output for a time and creating unemployment. However, **Richardo was more concerned which the consequences than the causes of technical change.** Pre-occupied as he was which the effects of technical change in the distribution of income on accumulation, he accepted but did not take further, Adam Smith's analysis of the division of labour and its effects in productivity.

KARL MARX

Marx was concerned with **productivity, its causes and consequences** and the **contributions made by the development of machinery.** It is for this reason that Rosengbeng (1982) has suggested that Marx's formulation of the problem of technological change "deserves to be a starting point for any serious investigation of technology and its ramifications". For Marx, **the machine producing sector** lay at the heart of the dynamic process of accumulation. Beginning where Smith left off, Marx agreed that the division of labour in manufacture (literally, production by hand without the use of machinery) gave rise to the emergence of a specialized machine-producing sector and hence to machinofactize" unlike in the period of handicraft production, which preceded manufacture. Manufacture led to a process of division of labour which was soon extended to the tools used by workers. He writes; "Manufacture is characteristic by the differentiation of the instruments of labour a differentiation whereby tools of a given sort acquired fixed shape, adapted to each potential application – and by the specialization of these instruments this manufacturing period simplifies, improves and multipliers the implement of labour by adapting them to the exclusive and special fixings of each kind of workers". It thus creates at the same time one of the material conditions for the existence of machinery, which consists of a combination of simple instruments (Marx, 1976; 460-461).

However, giving beyond Smith, Marx argued that the production of **machinery led to the undermining of the manufacturing** firm of production itself. He writes: "manufacture produce the machinery with which large scale industry (i.e. machinofacture) abolished the handicraft and manufacturing systems in the sphere of production put first seized hold of. The system of machine production therefore grew spontaneously on a material basis which was inadequate to it. According to Marx the introduction machinery involves the replacement of subjective, human control of the production process by mere predictable and controllable natural forces. In this way the conditions are created for the conscious application of science to production. "As machinery, the instrument of labour assumes a material mode of existence, which necessitate the replacement of human forces by natural forces, and the replacement conscious application of natural science".

By applying science in the design and production of machinery, productivity may be increased and hence costs reduced. "Like every other instrument for increasing the productivity of labour machinery is intended to cheapen it is the **relative price** (i.e. market price rather than value) of labour power and machinery that will govern the **introduction** of machinery since it is this that will determine actual costs and hence influence the actions of capitalists under the pressure of competition. Accordingly, production techniques will be expected to differ between countries which different relative prices.

The argument that the introduction of machinery depended on relative factor prices was not original to Marx and had been expressed earlier by Ricardo. Similarly, Marx's statement that the individual capitalist, has "a motive … to cheapen his commodities by increasing the productivity of labour" was also unoriginal. Marx's observation that the individual capitalist who increased his productivity above the average (social) level "realizes an extra simples value" is very much

in line with Adam Smith news on the self-interest of producers. However, Marx certainly went beyond his predecessors whereby more productive methods of production became generalized over time. For it is here that what Marx refers to as a social process rather than individual motives are determinant. It is these process that lie at the heart of Marx's concept of value which differs qualitatively from that of Ricardo. As this discussion makes clean, two or more **techniques** of production can **co-exist** at a given point in time only if they fulfill the following rec. conditions:

(1) they meet market requirement in terms of product price and quality and

(2) they generate the average rate of profit.

If a technique does not meet both these conditions then, either it will become obsolete (it uses will ones time go bankrupt or have to be subsidized) or total factor productivity obtained in using the technique will have to be sufficiently increased. An attempt to achieve the latter may result in improvement in machinery and/or change in other factors affecting total factor productivity such as changes in the division labour and the labour process. (Marx devoted a good deal of attention to the productivity effects of changes in the organizations of labour and these discussions complement the analysis of machinery). Following Ricardo, Marx argued that increases in productivity (through important in machinery and/or the labour process) would positively affect the rate of accumulation through decreases in the wage share (or, in Marx's terminology, the value of labour-power) this would be achieved through decreasing the real cost of labour. Accumulation achieved in this way was referred to by Marx as the production of relative surplus value.

Foundation of Evolutionary Economics

Veblen sees the evolutionary metaphor as crucial to the understanding of the process of technological development in the capitalist economy. He is the first economists to apply the Darwinian evolutionary analogy from biology to economics. He argues that economics become an "evolutionary" and "post Darwinian" science there is a current revival in evolutionary approaches in economics but the Veblen precedent for this type of approach is not always acknowledge. Biological evolutionary is based on three essential features.

- First, there must be sustained vaccination **among the members of a species in population. Variations may be blind, random or purposive** in character, but without them, as Darwin insisted, natural selection cannot operate.
- Second, there must be some **principle of heredity** or continuity through which offspring's have to resemble their other members of their species. In other words, there has to be some mechanism. Although which individual characteristics are passed on through the generation.
- Third, **natural selection** itself operate either because better-adopted organism leave increased numbers of offspring or because the variations or gene combinations that are preserved are those bestowing advantage in struggling to survive. This is the principle of the struggle for existence.

THEORIES OF THE FIRM IN TECHNOLOGY AND DEVELOPMENT

CHARACTERISTICS OF TECHNOLOGY

Defining technology as a package of technical information useful in the production of a given good or service, i.e., as a factor of production, various peculiarities have been noted in the literature. Firstly, in as much as it has some of the properties of the so called "public good"

technical information is indeed a very special factor of production. The usual rules concerning competitive resource allocation become inapplicable and questions of appropriability of optimal patterns of investment of divergence between social and private costs and benefits etc. come up and now have to be dealt with at the conceptual and quality levels. Secondly, rather than being exogenously given and freely and instantaneously accessible to everybody, new technical knowledge and information had to be systematically sought for by manufacturing firms. This obviously implies time and cost in as much as firms need to engage themselves in technological search efforts of different sort. Such efforts are:

a) Highly sensitive to the micro and macro atmosphere and market regime in which firms operate and
b) Highly idiosyncratic of the particular enterprise which undertake the search.

Thirdly, a package of technical information is almost never:

i) Completely specified
ii) Perfectly understood
iii) Easily replicable (inimitability)

Rather, as Nelson (1979) has pointed out there is a large element of tacitness, inimitability and imperfect understanding, underlying the notion of technical knowledge.

TECHNOLOGY AND THE MARKET MECHANISM

The production technique is the package of technical information, indicating how to perform a given economic activity, that is, the production of a good or service. Such package of technical information will normally consist of:

1. The design and engineering of the product (or service) in question.
2. A production process or basic manufacturing routine and
3. An industrial organization arrangement (degree of vertical integration, patterns of sub-contracting etc.)

Information on all 3 of these technical levels would be required in order to perform any economic activity. The above definition of a production technique is somewhat broader than one usually employed by the profession which is basically limited to a notion of a given capital-labour ratio, that is to the specific production technique or the manufacturing routine needed to carry out the activity.

Technical change is a change in the package of technical information employed by a given firm and that such change could be related to any one of such of the 3 previous characterized areas: that is it can involves a change in the product design, in the production process and /or in the industrial organization routine followed by the plant.

Special characteristics which make technical information a factor of production:

1. ***Technical information is a public good***: unlike other commodities "if one gives another person a piece of information, it does not diminish the amount of information that the first person has". As with other public goods, competitive market will normally lead to undersupply.
2. ***Information and appropriability:*** in spite of having some of the features of a public good, technical information is only partially so in as much as there are the appropriation of returns. Such methods, however, restrict dissemination and lead to suboptimal aggregation of technical information and the static inefficiency in resource allocation. (The appropriation of returns through patent rights, secrecy, etc., is invariably associated

with monopoly power although it is the expectation of future monopoly power which lead firms to devote resources to research and development).

Implication, then of monopoly power is obvious; it leads to insufficient utilization of the knowledge– production is restricted and the information is not disseminated enough. (There is then a trade-off between dynamic efficiency, providing adequate incentive for engaging in R &D and static efficiency, the correct utilization of the knowledge once obtained.)

3. ***Increasing returns to the use and production of technical information:*** returns to the generation of technical information would be larger, the larger the scale of production as the same piece of information can be use at any scale of output. Thus, the unit cost of technical information decreases as the scale of output increases. As for the production side of technical information, there seems to be a minimum threshold for which, it just does not pay to search for new technical information. Beyond such threshold, increasing returns seem to underlie the generation of new technical information.
4. ***The common pool property:*** in so far as the production of technical information draws upon a common pool of pre-existing technical information some of the returns to the former actually, constitute rent on the latter. As in other cases of common pools, this situation might lead to excessive entry. It is also true, however, that the benefit of producing technical information are not normally captured in its totality by the agent that performs the search effort and therefore technical search activities contribute to the common pool as well as take out from it. The net balance is difficult to judge a priori.
5. ***Uncertainty:*** (concerning the innovation process). Innovation is basically an uncertain process at the level of any particular innovation in so far as knowing what will be best route to follow and it involves uncertainty in the choice of projects from within the vast spectrum available. In addition, the perception of the probability of success and therefore its strategy depends on inter-active effect of economic, technical and institutional factors.

   In addition, to the above properties Nelson (1979) has singled out three other aspect of technical information; namely

   a) A certain amount of tacitness
   b) Some degree of inimitability
   c) Incomplete understanding

STANDARD MICROECONOMIC THEORY

Standard microeconomic theory focuses on how economic decisions are coordinated by the market mechanism. The model of a competitive market is an important benchmark for understanding how markets operate. It shows how coordination between quantities demanded by buyers and quantities supplied by sellers is achieved by the price mechanism. The standard microeconomic theory is based on 4 assumptions:

1. ***Firms are holistic entities:*** which means one firm is assumed to be a single unified entity. The result is that in standard microeconomics one does not consider what goes on inside the firm. It is as if the firm is simply a black box that one cannot look into. (This first assumption is relaxed in more modern approaches. It is quite obvious that, if you want to discuss organization, we have to look inside those organizations).
2. ***Firms have a single objective:*** maximize profit. This assumption means that the objectives of the owner(s) of the firm are the only objectives that matter.

3. ***Everyone has perfect information:*** However, organizations arise mainly as a solution to information problems. If you want to understand why not all economic decisions are coordinated by the price mechanism of standard microeconomics, then we have to relax this assumption.
4. ***The behaviour of producers and consumers can be described as maximizing behaviour.*** This assumption typifies the "homoeconomicus" who knows everything and makes decisions solely on the basis of calculating the solutions of some maximizing problems. But human beings are unable to calculate optimal solutions to all circumstances.

Let us examine some assumptions in some detailed.

1. ***The single owner-entrepreneur:*** the firm is a complex organization characterized by the divorce of ownership and management. This gives discretion to the manager to pursue goals other than profit maximization. Information is not unlimited. Its acquisition involves expenses. Managers cannot act with the global rationality, not only because of the limited and distorted information but also because they have neither time nor unlimited abilities to compare and evaluate all possible alternative strategies open to them in any particular situation.
2. ***Goal of profit maximization:*** firms pursue a multitude of goals and profit is only one of them. Alternative goals include:
   a) Managerialism: Maximization of the managerial utility function. Thus managerial theory postulates that the divorce of ownership and management allows some discretion to the manager in goal-setting. The managers select such goals which maximize their own utility function. Factors that usually enter the managerial utility functions are salaries, prestige, market share, job security, quiet life, etc.
   There is no consensus among managerial theorist as to how the maximization of the utility of managers would be attained. Baumol postulated that the managerial utility is maximized when the growth of sale revenue is maximized. Marris is more sophisticated. He ingeniously suggests that the managers pursue the maximum "balanced growth" that is the balance increase of both sales and capital assets of the firm. If this is attained, then both the utility of manager and owners of the firm (shareholders) is maximized.
   b) ***Behaviourism:*** satisfying behaviour. Some writers have suggested that, given the uncertainty in the real world, the lack of accurate information, the limited ability of managers to process information and their constraints, firms cannot act with global rationality implied in the traditional theory of the firm. Indeed the uncertainty makes impossible the maximization of anything. Given these conditions, firms do not seek the maximization of profit, sales, growth or anything else. Instead they exhibit a satisfying behaviour. They pursue a satisfactory profit, satisfactory growth, etc. this behaviour is considered rational given the uncertainty of the real world. Firms act with bounded rationality set by factors internal and external to the firm.

THE BEHAVIOURAL THEORY OF THE FIRM

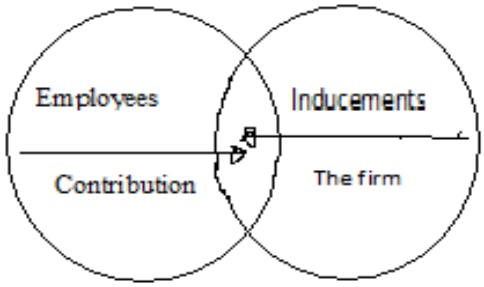
Introduction

In standard microeconomics it is assumed that firms are holistic entities that seek to maximize profit. By contrast, the behavioural theory of the firm, postulates the firm as a coalition of (group

of) participants each with their own objectives. Such a coalition of participants need not have maximization of profits as its sole objective.
In fact, the process of defining the goals of the organization is first step in describing actual decision making processes within the firm. The second step is to describe, how the organizations forms expectations upon which the decision process are based. The third step is to describe the process of organizational choice.

The firm as a coalition of participants

The behavioural theory of the firm postulates the firm as a coalition of participants. Each participant receives from the organization inducements in return for which he makes contribution to the organization. Each participant will continue his participation only as long as the inducement offered are as great as or greater than (measured in terms of his values and in forms of the alternatives open to him) the contribution he is ask to make. Hence the organization will continue to exist as long as the contributions are sufficient to provide inducement in large enough measure to draw forth these contributions.
Participants in the firm are employees; investors, supplies, distributors, consumers and possibly others. Contributions made by employees include not only the labour hours they put but also their ideas for improvement, the intelligence and so on. Inducement offered to employees include monetary payment (retirement plans etc) but also non-monetary benefits such as self achievement and job satisfaction. The relationship between the firm and its employees is illustrated in fig.1



The relationship between the firm and its employees in behavioural theory

The fundamental differences between behavioural and standard microeconomics lies in the information that employees have concerning alternative job opportunities. In standard microeconomics, we assume that each employee knows exactly what he/she could earn elsewhere. In behavioural theory we assume that each employee has an aspiration level concerning his wage rate. He is constant and will not start looking for another job so long as the wage he receives is greater than the required to meet his aspiration level. The process of adjusting one's aspiration level and looking for another job may take a considerable amount of time (inducement contains not only monetary payment but also other benefits information about these other benefits may be even harder to obtain than information about wage rate.)
For other participants we can stretch a similar picture concerning the decision its stay with the coalition or to leave. For example, consumers with aspiration levels with respect to price and

quality. For every group of participants, we can sketch a picture like fig. 1. If we do so and combine all these, pictures, we arrive at a picture like fig.2

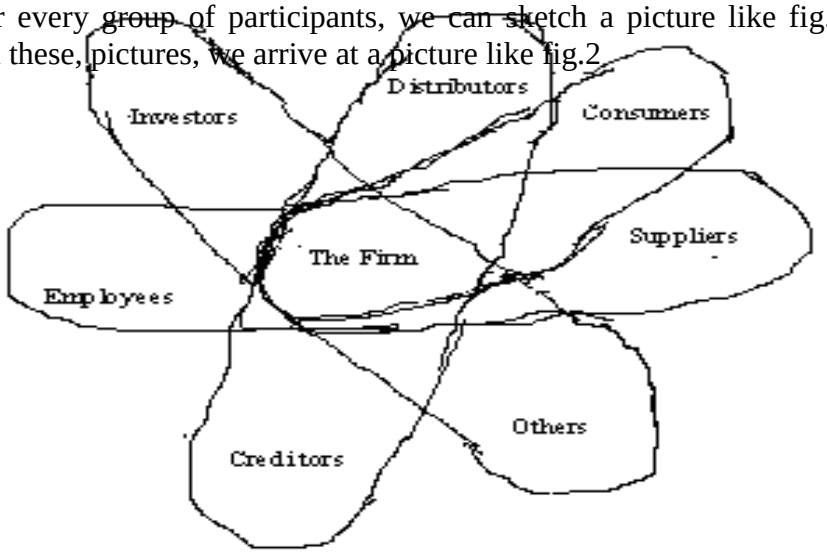


Figure2: Stakeholders of the firm

Fig. 2 shows the firm is a coalition of participants and that each group of participant has other roles and interest outside the firm. The groups of participants in fig.2 are often referred to as stakeholders (each group has a stake in the firm). Stakeholders include the investors (shareholders) as well as employees, suppliers, and customers.

According to standard microeconomics the firm should only serve the interest of shareholders. According to the behavioural theory, however, a firm can survive only if it managers take care of the interests of all stakeholders and not just the shareholders. It is clear from this discussion that in behavioural theory that there is a competition between the firm and the labour market and the market for the final product and the capital market. However, behavioural theory focuses not only the competition between firms but on the process of decision making within the firm. The competition contest on various markets is further taken as given.

The assumptions underlying the behavioural theory about the complex nature of the firm introduces an element of realism into the theory of the firm. The firm is not treated as a single-good, single-unit, as in the traditional theory but as a multi-good, multi-unit organizational coalition. The firm is conceived as a coalition of different groups which are connected with in acting in various ways, managers, workers, customers, shareholders, suppliers, bankers, tax inspectors and so on. Each group has its own set of goals and demands. For example, workers want higher wages, good pension scheme, and good conditions of work. The managers want higher salaries, power, and prestige. The shareholders want higher profits, growing capital and market size. The customers want low prices, good quality and service. The suppliers want steady contract for the material they sell to the firm etc. ***The most important groups, however, within the framework of the behavioural theory are those most directly and actively concerned with the firm, namely the managers, workers and shareholders.***

ORGANISATIONAL GOALS

Bargaining and organisational slack

In the behavioural theory the firm is viewed as a coalition of participants. In general, we expect a conflict of goals from different participant. Consumers cannot be offered lower prices and

employee's higher wages without lowering profits (the inducement for the providers of equity capital).
In behavioural theory, it is postulated that goals of the firm are arrive at through a bargaining process. During this bargaining process both the composition and the general goals of the coalition are established. The bargaining power of each potential participants depends on how unique the contribution of is that he can offered to the coalition.
For all participants, achievement levels would be at least equal to their aspiration level most of the time. For some it will be above their aspiration levels. Their difference between total resources and total payment necessary to preserve the coalition is termed the organizational slack.

Operational sub-goals
In the behavioural theory we assume that organizational sub goals are specified and given to functional departments. With each sub goal goes an aspiration levels. Managers are rewarded if they at least reach these aspiration levels. This does not eliminate conflict between managers of functional department. It is quasi resolution of conflict rather than resolution of conflict.
The top management have several tasks to set the goals of the firm which often are in conflict with the demands of the various groups; to resolve the conflict between the various groups; to reconcile as far as possible the conflict in goals of the firm and of its individual group, to take decisions in order to implement the set goals.
The goals of the firm are set ultimately by the top management. There are five main goals of the firm:

1. Production goal
2. Inventory goal
3. Sales goal
4. Share of the market goal
5. Means for the resolution of the conflict

Apart from the budget and the delegation of authority, the smooth functioning of the firm are secure by various means which the top management to resolve the conflict in the firm and the most important means for the resolution are:

1. ***Monetary payments*** ─ are a major means for satisfying the demand of the members of the coalition–firm
2. ***Side payment (which takes the form of policy commitment)*** ─ for example, the top management in order to keep a good scientist in its research department apart from paying him his salary (opportunity cost), must allocate certain funds for the development and conduct of the research plans (projects) of the scientist. These funds are money payments which off course do not go into the pocket of the scientist. They form a side payment for him, in the sense that they satisfy part of his demands which are associated with his research interest.
3. ***Slack payment:*** slack is defined as payment to the various groups of the coalition over and above those required for the efficient working of the firm. Organizational slack consists of payment to members of the coalition in excess if what is required to maintain the organization.
4. ***The sequential attention to the demands of the individual members or groups*** ─ for example, the top management depending on the urgency of the different demands

attached priority and satisfies first the demands that seem more important in any one period while postponing the demands of other members for future periods.

5. ***Decentralization of decision making (delegating authority for action within a given limit)*** — conflict is partly avoided if the decision area of member or group is well defined.

ORGANIZATIONAL EXPECTATIONS

Expectations are the result of drawing inferences from available information. Decision makers within the firm may have different information. In addition they may draw different inferences from the same set of information. Hence even if two people from the same firm have same information, they may still hold different expectation.

Suppose the sales manager makes a sales forecast each week will the production manager now use this sale forecast only? Empirical evidence shows that many production managers do not. They continue to make their own sales forecast. The reason is that, they know that:

1. The sales manager is more often than not too optimistic. May be people with optimistic nature tend to become sales managers
2. The sales manager have an incentive to make an optimistic sales forecast in order to reduce the probability of stock-out. This example demonstrate the use of expectation in decision making within the firm.

EVOLUTIONARY THEORY OF THE FIRM

The evolutionary theory is concerned with what happens within organizations and interactions between organizations and their environment, which include other organizations. Within the evolutionary perspective there are several explanations which account for the process of cumulative adaptation. One explanation can be traced to Larmack another to Darwin.

Larmack

The Lamarckian explanation is based on two principles.

1. ***The inheritance of acquired characteristics:*** this principle takes care of the inter-generational effect. Characteristics acquired by individuals can be inherited by future generations.
2. ***The principle of use and disuse:*** states that, those parts of an organisms body that are used grow larger. Those parts that are not use tend to wither away.

Darwin

The Darwinian explanation on the other hand emphasizes the role of cumulative natural selection. Individual (chance) variations and natural selections is a result of environmental conditions and retention (in the gene pool) of the adaptive characteristics due from the causal chain.

Why do giraffes have long necks

This question allows us to separate evolutionary and creationist arguments and within the evolutionary strand, Darwinist and Lamarckian arguments. Creationists' argument involves deliberate design. Giraffes were designed the long necks. These characteristics allows them to

survive among other species. Evolutionary argument on the other hand emphasizes cumulative adaptation. Giraffes were not designed with long necks, but gradually acquired them.

The genesis of modern evolutionary theories of the firm

So many years ago, Alfred marshal turned to biology for inspiration in his principles of economics and Thorstein Veblen suggested that the metaphor of Darwinian Evolution could be applied to economics. However, the development of the evolutionary theory of the firm is largely a post-1945 phenomenon. It largely emanates from a famous controversy about the legitimacy of the assumption of profit maximization in economics.

Opposing the assumption, economists such as Richard Lester and Robert Gordon appeal to empirical study of firm behaviour and argued that profit maximizing behaviour was neither typical nor feasible in real world. In contrast, the neoclassical economist fritz Machlup suggested that even if they were not fully conscious of them, business managers use complex, optimizing calculations just as we try to choose the optimum speed and position when trying to overtake another vehicle with a car.

This debate of profit maximization has continued to this day, with several notable and important contributions. What is significant for the development of evolutionary economics is a contribution to this debate by Armen Alchian. In an article "uncertainty, evolution and economic theory" (1950), Alchian argues that Lester and Gordon were both wrong. Alchian contended that, it did not matter whether firms were trying to maximize or not market competition created an environment akin to natural selection where the more efficient would win out. Selective success, Alchian argues, depends on behaviour and results not motivations.

In response to Alchian, Edith Penrose (1952) argued that, the biological analogy was misconceived for at least two reasons:

1. Human agents are guided purpose and intentions where Darwinian natural selection assumes that organisms are simply programmed by their genes.

2. The analogy was abuse, because there was not equivalent in the socio-economic sphere to durable heritable traits.

Accordingly, there is nothing durable upon which socio-economic natural selection can operate. Nevertheless, these important criticism were ignored and the natural selection idea was taken by others, notably by Milton Friedman (1953) ─ turning the natural selection into a defense of the neoclassical assumption of profit maximization. It is instructive to note that Alchian (1950) had no intentions of laying the basis of an evolutionary or alternative theory of the firm. What he did was to reintroduce and biological analogy back into economics which had been neglected after the deaths of Marshall and Veblen in the 1920s. In response to Friedman a, Sidney winter, wrote an extensive critique of Friedman's natural selection defense of profit maximization. However, instead of rejecting the biological analogy, he showed that rather, special and restrictive conditions were required for market competition to produce the results that Friedman presumes.

Winter pointed out that, Friedman natural selection argument was imperfectly specified in that, and it did not show how maximizing behaviour was replicated through time. Winter suggested that routines in the firm have a relatively durable quality through time. They may help to retain skills and other forms of knowledge, and to some extent they have the capacity to replicate through mutation, personal mobility, take-overs. Further, routines can change through managerial or other actions when the firm's profits are below satisfactory level. Hence winter's work is a partial answer to Penrose a as well as a direct attack on Friedman.

THE NELSON-WINTER APPROACH TO EVOLUTIONARY THEORY OF THE FIRM

In their work, an evolutionary theory of economic change (1982) the economists Richard Nelson and Sidney Winter outline (another) their evolutionary perspective. Their primary concept to denote organizational functioning is Routines. Routines refer to all regular and predictable behaviour patterns of the firm. There are production routines as well as strategic routines. We consider two aspects of routines.

1. Routines serve as organizational memory. Organizations largely remember by doing according to nelson and winter. Routines which are not use for some time wither away. The organization loss the capacity to perform such routines. Individuals loss the required skill to perform the routines and to play the organizational role required of them. Routine-like coordination is disturbed. Memories are further endangered when there is individual turnover. Turnover is one cause of mutations in routines.

2. Routines also serve as an organizational treaty. By this metaphor, nelson and winter refer to the behavioural foundations of their concept of organization. Satisfying takes the place of maximizing and the existence of organizational conflict is not assumed away. Routines may be seen as a stabilizing force in organization.

However, it is freely accepted that, innovative activity is possible and much business behaviour is not essentially routines. Just as routine is the analogous, of the gene, nelson and winter borrowed another key concept directly from evolutionary biology and developed *the concept of search to encompass changes in the routines of firms*: "our concept of search obviously is the counterpart of that mutation in biological evolutionary theory" (Ibid). The concept was illustrated by the evolutionary model. A threshold level of profitability is assumed. If firms are sufficiently profitable, they attempt to maintain their existing routine and do no searching at all. Here nelson and winter adopt Herbert Simon's *satisfying idea*: agent attempt to gain a given aspiration level rather than optimize. However, if profitability falls below this level then firms are driven to consider alternatives. They invest in R and D and attempt of discover new techniques so that profitability can be restored.

3. There is a clear analogue to the idea of economic natural selection: "market environment provide a definition of success for business firms, and definition is closely related to their ability to survive and grow. Clearly, there is the application of the analogy of market biology.