

UNIVERSITY OF PORT HARCOURT

**BEYOND THE BANKRUPTCY OF THE
DISMAL SCIENCE**

An Inaugural Lecture

By

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Introduction

Protocol

Pro-Chancellor, Sir

The Vice Chancellor, Sir

Members of Council here present

Principal Officers of the University here present

Provost, College of Health Sciences

Deans of Graduate School and Faculties

Distinguished Professors

Heads of Departments

Dear Colleagues

Distinguished Guests

Gentlemen of the Press

Staff and Students of Unique Uniport

Ladies and Gentlemen

It is indeed with great honour, sense of humility and responsibility that I stand before you, this day, to deliver this lecture, which is the fourth in the series of inaugural lectures from the Department of Economics at this University. I have the pleasure of welcoming you who have come from far and near to assist in celebrating a belatedly inaugural lecture.

Acknowledgements

Vice Chancellor, Sir, please permit me to acknowledge my indebtedness to the many people that had helped in their various ways to midwife this day. It is when I sat down to write this lecture that I came to realise how indebted I am to so many people known and unknown. Even the known list is so large that I am forced to be selective. So, if I fail to acknowledge you explicitly, it does not in any way mean that I do not profoundly appreciate your contributions. More importantly, I have come to regard you all as true friends that have not only left footprints in the chapters of the book of my life but also in my own heart.

First among them is of course the Vice Chancellor for giving me the opportunity to present this inaugural lecture, thank you, Sir.

The lecture is dedicated to the sweet memory of that singular woman who had the first right to refuse this day but graciously did not – the Late Madam Lillian March Jimsele Agiobenebo.

I thank the orator for his favour.

My sincere and deep appreciation goes to the memory of Chief (Sir), Senator (Dr) Francis J. Ellah, a Permanent Secretary I served in the capacity of a Messenger and a Registrar, I served as a Clerical Assistance on secondment; whom I never knew was watching my activities, assessing my potentials and believing firmly in me and gave me the unsolicited environment that allowed me to combine work and study conveniently.

I would also like to thank a former Vice Chancellor of this University, Professor (Sir) Sylvanus J. S. Cookey. I was once again at one of those cross roads in my life; where the doors for finishing my doctoral programme at the University of Pittsburgh were all closing against me such that I was forced to

change job from the Rivers State University of Science and Technology to the University of Port Harcourt when the Staff Development Policy of this University had changed in response to changing economic and funding landscapes but who had the administrative will to give me a Staff Development Award despite the challenges that enabled me to finish my doctoral programme at the University of Pittsburgh. Without this award, this day might not have been. I will ever remain grateful.

I don't know how to thank the family of Late Professor Jerome C. Wells, his wife, Nancy and little David then. It was Jerry that called me at the end of my final examinations at the Ahmadu Bello University, where he was a Visiting Professor of Economics and said to me "you are one of our best students; you will do well in an American University, think of doing graduate work in America". I had more than one admission offers. But, when I sat down to make the decision as where exactly to go, something in me advised, if you are going to a so faraway place, go to where you know someone. So, I choose Pitt and this decision saved my life and family. It was Jerry and Nancy that took care of me in my first term at Pitt, winter 1979. I thank them immensely, despite the fact that I had a State Government Scholarship and a Staff Development Award from the then Rivers State College of Science and Technology.

I am also very grateful to the Authorities of the University of Pittsburgh for the fellowships they gave me that enabled me to complete my course work for my doctoral programme at the University.

The group of five to whom I also owe a deep appreciation is my Dissertation Committee at Pitt, namely, Professor Jerome C. Wells of blessed memory (Chairman); Professor Gene Gruver (Co-Chairman); Professor Asatoshi Meshiro; Professor Janet Chapman; and Professor Saul Katz,

they guided me in the most diligent way a student should be guided as a team and I remain grateful to them.

I am indebted to my senior colleague, friend and mentor, Professor C. S. Nwodo for helping me even with the title of this lecture and to Professor Francis D. Ukaigwe and many others friends for all their love and support.

To Professor Augustine Ahiazu whom I met at his Advanced Evening Classes that I couldn't even pay for regularly but who noticed me and would come around my place in Mile 1, Diobu to wake me up from sleep, and say to me "wake up, your mates are professors in the universities and you are here sleeping, wake up, go and read", I remain grateful.

There is this special person, who started it all, whom to my friends I have presented as my God Father. Our paths crossed by the incidence of my double promotion from Standard 4 to 6 in 1963 and we became inseparable ever since. He is the Angel that was sent at the end of the Nigerian civil war to give me direction. We have not seen or heard from each other since the Fall of Grand Bonny, perhaps believing that the other was lost to the war. Then, one precious day he appeared and I asked if he was a ghost or real. He replied he is real and that he has come for me. I should not stay at home. He has two rooms in Port Harcourt and a job with Nigerian Airways; we will go to night school in Port Harcourt. This very special individual in the book on my life is Chief Dokubo Obu Igbanibo, I will ever remain grateful.

How does a man thank his family that has made so much sacrifice as mine? To that singular woman who had singled mindedly sailed with me through the rough seas of life on this planet, who I had always looked upon as my soul mate and a widow of living husband – my wife, Mrs. Ada Tamunopriye Agiobenebo, I say I can't thank you enough for your immeasurable love. To my children, whose cries, smiles

and laughter are all tonics for the struggle to this height. And can I leave out my grandchildren who have increased the Agiobenebo clan but also brought me new hopes and joy. I thank you all for the various ways you have seen me to this moment.

My ultimate gratitude goes to the Supreme One, the Author of life for the gift of life itself; for all that has been and has not been and for all that will be and will not be in this life time and into eternity.

The Nature of this Lecture

Inaugural lectures may be defined variously but the recognition of two things prove to be the running thread, namely, it announces the arrival of scholar at a position of leadership having been given a chair in his/her field and to announce his/her next trajectory (trajectories), i.e. to explore the frontiers of the distance between the known and unknown of his/her own universe of work. This lecture is slightly different. It has come so late in time that it does not fit directly into the orthodox description of an inaugural lecture. So, I shall use it to recognise that I have earned a Chair in my discipline and to report on the trajectories that I have walked so far and may continue to explore.

The Origins of Economic Science The Seven Days of Creation Story

Insert multi-media clip here

Vice Chancellor, Sir, all other protocol duly observed, the title of my lecture is not the economics of religion; not even the economics of creation but “Beyond the Bankruptcy of the Dismal Science”. I am acutely aware that religion and economics are not strange bedfellows.¹ The video clip you have just watched is to motivate what I am going to present to this august gathering as the “fourth science”. I deny that the first, second and third sciences I know. My observations regarding the manifestations on our planet tend to have varied composition of physical, chemical and biological elements. Unfortunately, however, I have no measurement of the proportions and worse still the proportions seem to be relative rather than absolute; and vary widely across the species;

¹ After all, capitalist market economy can be traced back to the Caliphate where the first market economy and earliest forms of merchant capitalism took root between the 8th-12th centuries (see http://en.wikipedia.org/wiki/Ancient_economic_thought).

therefore, I am unable to order them.² Yes, one can still hazard a guess but that would only be controversial, so the matter is rested.

For the purposes of this lecture the creation story as given in King James Version of the Bible is taken for granted.³ The insight from the video clip is that economics had been there since the beginning of creation and we all have used it, interpreted it and discussed it in own various ways. The reasoning is simple. All the effort at creation would have come to naught if there is no evolution. Now, there shall be no evolution if there is no sustenance. There can be no sustenance if there are no resources. However, the existence of resources is necessary but not sufficient for evolution to take place, in particular sustainably; since, evolution requires sustainability to be meaningful and economic. If the resources required are finite and depletable in nature that is even if just one of them exhibits these properties, then management of the carrying capacity of the “Garden of Eden” is imperative. For the purposes of this lecture, the Garden of Eden is not larger than planet Earth.⁴

Noah’s ark is a regional sample of the Garden of Eden. The reason for the regional perspective of the Ark is obvious. The human races seemed to be subsumed in the Jewish race (perhaps presumed a representative sample). Further, it is tempting to ask why Noah limited his saving of the species to just the reproductive couple of each specie? This puzzle may simply be resolved as a commandment of God. But, it is

² I understand that for quite a number of people (example Samuel Brittan (2003), physics is the father/mother and prime science and that only the natural sciences are sciences.

³ I am aware that there are other versions of the story of creation, but this version is adequate for the purpose of this lecture.

⁴ I am aware that other planets exist, after all, the Moon has been landed and there are scientific explorations into its habitability. Those possibilities when they become realities can only shift the constraint of carrying capacity forward but even with that there will always be upper boundaries.

intriguing that he did not even attempt to save any of the plant species. My suspicion is that he was constrained by the carrying capacity of the Ark. The carrying capacity even when conceived as a moving variable will always have a finite upper limit in time and space. Once an upper limit is admissible, management of the carrying capacity becomes imperative. It is possible that the frontier of the constraint might be shifted outwards from time to time by new discoveries in space (new locations with deposits of resources), science and technology and innovations in management but it will always be there. Economists usually represent the upper limit by the production possibility frontier as shown in Figure 1b.



Figure 1a: Noah's Ark

Source: Circulated from the Internet at the University of Botswana (2005)

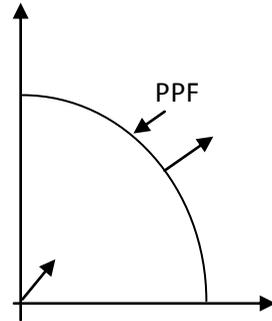


Figure 1b: The Production Possibility Frontier

The situation in Noah's Ark exemplifies the source of the worries of Anyanwu (2009) in his "Population Interactions" and the six broad categories of competition that

characterise them and their implications as well as Nyanayo (2008) worries over the environment and biodiversity.

The Evolution of Economics

The study of the evolution of economics is essentially a study of the history of economic thought and methodology, which deals with different thinkers and theories of the subject that became political economy and ultimately economics from the ancient world to the present day. Understanding the history of economic analysis, even if in an outline form, will be helpful in understanding the logic of the evolution of economic science and the structure of economic theory as well as its models of scientific knowledge growth as the predecessors of modern economic problems. That is, where is economic analysis coming from, where is it now and where is it tending to? There are several possible ways to categorise and organise the evolution of economic science. But, here focus is laid only on some crucial moments in the development of economic ideas that are relevant for the theoretical and methodological debates of present times. It is divided into four parts, namely, ancient, medieval or middle ages, classical and modern times; taking both historical and methodological perspectives as shown in Figure 2.⁵

This is despite the fact that some prominent classical scholars assert that relevant economic thought did not arise until the enlightenment period, as early economics was based on metaphysical principles which are incommensurate with contemporary dominant economic theories such as

⁵ The periods are regarded as open and overlapping in the sense of covering intergenerational Schools of Thought. After all, ideas do not simply die and get buried, they struggle and compete with the emerging new thoughts that seek to cast and bind them. And this is simply natural in the struggle for survival.

neoclassical economics, (Lowry (2003), which cites especially Meikle (1995) and Finley (1970)) on this score.

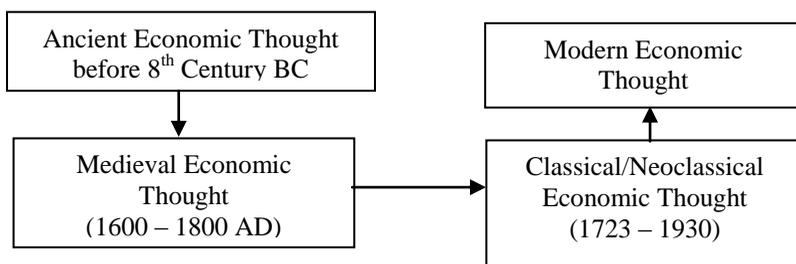


Figure 2: Development of Economic Theory
Arrowheads show the direction of progress

Economic thought in Antiquity

It is questionable if the ancients really had economic theories of their own, if the reference is to “the history of the analytic or scientific aspects of economic thought” ala Schumpeter (1954). After all, no grand analytical systems existed until the mid-eighteen century before the birth of classical political economy in England. This notwithstanding, Ptak (2006) asserts that the ancients of the likes of Hesiod, Democritus, Xenophon, Plato and Aristotle provided significant insights into economic theory through their praxeological deductions. Hesiod is often labelled the first economist who dealt with the problem of scarcity as far back as the 8th century BC and even competition, which he saw as good conflict that tends to reduce the problems of scarcity. Democritus, born in 460 BC, a contemporary of Socrates, dealt with subjective value theory, and time preference.

Xenophon, an Athenian aristocrat and army general, was a contemporary of Plato too, who developed a utility theory of value as reflected in his definition of property, namely, “property is that which is useful for supplying a livelihood, and useful things turned out to be all those things that one knows how to use” as well as providing insight into

the theory of profit. In fact, he is seen as the first to write disquisition of economics, which translates from the Greek "economic" to mean a science of housekeeping. With the development of exchange and the forming of national markets arises the necessity of a wider interpretation of the notion "economics" and in 1615 a French scientist A. Monkretien introduces in inversion of the term "political economy" that in translation from Greek means "art of state management of economy", which is founded on a principle of diligent management, developed through experience, as a result of generalisations of economic practice.

To Ptak (2006), Stoic thought (Circa 323 - 31 B.C. also called the Hellenistic Period) presents a coherent notion of natural law; while those of Lao Tzu, Chuang Tzu, Pao Chingyen, and Ssu-ma Ch'ien, and Taoists in Ancient China, provides insights into the spontaneous order of the market and the effects of government intervention. The Late Scholastics, including Jean de Pierre Olivi, Albornoz, Mercado, Saint Bernadino, and Juan de Mariana, contributed to the economic discussion of utility theory, international trade, private property, the nature of government, and currency debasement.

The focus here however is on the writings of Plato (427-347 BCE) and Aristotle (384-322 BCE).⁶ The idiosyncrasies of the ancient social concepts, such as "Household theory" and Plato's division of labour and distribution theory are under reference here. Indeed, many economic concepts and thoughts are traceable to the ancients. For example, Foley (1974) has suggested that Adam Smith could not have gotten his original inspiration for the division of labour principle (not from the usual sources cited but from

⁶ I am acutely aware that this list is non-exhaustive. There are many other ancient economic thoughts; even Hammurabi's code of laws may be relevant here. Besides, there are different legitimate ways of doing and organising history of economic thought. Further, it should be obvious that the focus is on formal discussion of economic issues.

the Greeks most especially Plato). He goes on to assert that Plato provides an explicit model for Smith's four-stage theory of economic development as Plato has Socrates remarked in *The Republic* that specialization occurs because we are not all alike; there are many diversities of natures among us which are adapted to different occupations.

The ideas of Aristotle have had a tremendous impact on social and economic thought⁷. It was he who recognised the vital importance of private property and denounced the communism of the ruling elite advocated by Plato. According to Aristotle, Plato's collectivist utopia runs counter to humanity's multiplicity and the mutual advantage gained through market exchange. Aristotle's greatest contribution is in his recognition and outline of the common characteristics of private property that solidified his support. They include:

- ❖ Private property is more productive and leads to progress.
- ❖ Conflict is inherent in communal property management.
- ❖ Private property is intrinsic to man's nature. The love of self, money, and property is tied to natural love of exclusive ownership.
- ❖ Private property has existed always and everywhere.

⁷ This unit draws heavily from Ptak (2006), "The Prehistory of Modern Economic Thought: The Aristotle in Austrian Theory" (see www.mises.org/journals/scholar/Ptak1.pdf; accessed 20/06/2009)

- ❖ Only private property allows for opportunity for moral action; to practice virtues of benevolence and philanthropy.

According to Ptak (2006), Aristotle also had a generally positive and accurate view of money despite his unfortunate comment that the lending of money at interest was “unnatural”. He correctly identified the growth of money as a catalyst for increased production and exchange. He sees money as a medium of exchange that is representative of general demand and thus “holds all goods together.” Aristotle goes on to explain that as everyone sells goods for money the problem of the “double coincidence of wants” is eliminated. No longer does each trader have to covet the other trader’s goods directly.

Aristotle appreciates the fact that money represents human need or demand thus providing the motivation for exchange and “which holds all things together.” Demand is governed by the desirability of a good or use-value. Aristotle approaches a cogent analysis of the impact of different levels of supply on the value of a good. An echo of a marginal utility theory of value and its resolution of the paradox of value can also be discerned. Aristotle states that the quantity of a good reaches a saturation point where the use-value plummets and becomes insignificant. He points to the inverse effect that when a good becomes scarcer, it will become subjectively more valuable. In the Rhetoric, Aristotle states that “what is rare is a greater good than what is plentiful. Thus gold is a better thing than iron, though less useful”; although not a complete refutation of the paradox of value, it was much closer than many economists of the eighteenth century could get to.

Aristotle correctly identified the process by which the value of final products is imputed to the factors or means of production. In the Topics as well as in the Rhetoric, Aristotle states that the “instruments of production” derive their value

from the “instruments of action”, the final products useful to man. The greater subjective value of a good, the greater the value of the means to arrive at that product; Aristotle thus touched on the marginal component in this imputation stating “judge by means of an addition, and see if the addition of A to the same thing as B makes the whole more desirable than the addition of B.” Aristotle correctly emphasises the value of the loss rather than the addition of a good. “That is the greater good whose contrary is the greater evil, and whose loss affects us more.”

Aristotle’s analysis continued as he pointed out that a saw is more valuable than a sickle in the carpentry profession, yet it is not universally more valuable. The factors of production play an important role in the whole process. Aristotle also noticed that a good with many potential uses will be more desirable than a good with only one use. Aristotle provided clear insight into the economic theory of imputation and marginal productivity tackled by economists more than two thousand years later.

In general, the concerns of the ancients involved a number of issues which they held in common, the answers to which are the basis of the structure of well-functioning societies today as much as in those early times. The issues include how to make markets, taxation policies, and other monetary instruments transparent and free from corruption; when is profit permissible (and how much) based on the labour of others, such as in the case of merchants, the charging of interest and when does it become unacceptable usury; and other practices that would otherwise **destroy the well-being of ordinary law-abiding people on which strong and unified states were built**. While their ideas were not always complete, and in some cases involved long-lasting debates rather than answers, much similarity can be found in their efforts. It is also of note that early economic thinking, closely tied to

philosophical and/or religious tenets, generally took into account the welfare of the common man, the worker, rather than seeking ways to benefit a few elite individuals, themselves or others (see “**Early economic thought**”, New World Encyclopedia).

Humans undoubtedly behaved economically for many centuries before they undertook to analyze their economic behaviour and arrive at explanatory principles. At first, this analysis was more implicit than explicit, more inarticulate than articulate, and more philosophical, political and religious in mode than economic. But in the face of ubiquitous and inevitable scarcity, the study, in various forms and for various proximate purposes, went on, (Spengler and Allen 1960:2). It is clear that the earliest writings were not clearly separated from other discussions, particularly those of justice and morality.⁸ This reflects the reality of early societies — as Karl Polanyi noted, early economies were “**embedded economies**,” not separate and certainly not dominant institutions (Eggleston 2008).

Economic thought in the Medieval and Middle Ages

Even in the medieval period, Economics was still in the public domain discussed by pamphleteers and all other sorts of discussants without a corpus of professionals. Economics was not considered a separate discipline until the nineteenth century. Yet, economic thought has existed from the ancient world right up to the present ages. Further, Aristotle’s economic ideas were rediscovered in medieval scholastic thought in the political philosophy of Thomas Hobbes (1588-1679), whose ideas influenced Mercantilist economic writings; with the philosophy of John Locke (1632-1704), the father of

⁸ Perhaps this and the fact that it was led for a while by moral philosophers may be why economics is often regarded as moral science

‘Classical Liberalism’, who provided the philosophical foundations for the classical British economists including Adam Smith, David Ricardo, and Rev. Thomas Malthus. Indeed, the thoughts of the ancients resonated in the writings of Early Christianity and the Scholastics.

Influence of the Early Church and the Scholastics

The Scholastics were a group of thirteenth and fourteenth century theologians, who took on the role of guiding society, notably the Dominican Thomas Aquinas that set down the dogma of the Catholic Church building on Greek thought as revived by twelfth and thirteen century Islamic scholars such as the Persian philosopher Nasir al-Din al-Tusi (1201-1274) who presented an early definition of economics (what he called *hekmat-e-madani*, the science of city life) in his *Ethics* (the study of universal laws governing the public interest (welfare?)).

Perhaps the most well known Islamic scholar who wrote about economics was Ibn Khaldun (732-808 AH/1332-1404 C.E.) of Tunisia. Joseph Schumpeter (1954: 136) mentions his sociology and others. Hosseini (2003) considers him the father of modern economics. It is his insight into the laws governing human behaviour and socio-economic phenomena like division of labour, growth and decline of population, and rise and fall of prices, which distinguished him from many other social thinkers. The focus of his attention was the various stages of growth and decline through which, according to his insight, every society must pass. This theory has been compared with John Hicks' theory of trade cycles (Weiss 1995: 29-30).

Ibn Khaldun's idea about the benefits of the division of labour relate to *asabiyya*, the greater the social cohesion, the more complex the successful division may be, the greater the economic growth. He noted that growth and development

positively stimulate both supply and demand, and that the forces of supply and demand are what determine the prices of goods (Weiss 1995: 31). He also noted macroeconomic forces of population growth, human capital development, and technological developments effects on development. In fact, Ibn Khaldun thought that population growth was directly a function of wealth (Weiss 1995:33).

A distinctive feature of Ibn Khaldun's approach to economic problems is his keenness to take into consideration the various geographical, ethnic, political, and sociological forces involved in the situation. He did not confine himself to the so-called economic factors alone. He would rather examine whatever forces he found relevant to the issue under study. It is in this context that one can appreciate his tendency to take a people's religious beliefs and traditions into account while discussing their economic behaviour and social institutions. He was fully aware of the truth that production of wealth is not a result of individual labour and enterprise only. It owes itself as much to man's social and socio-political institutions, especially the state and its administration.

Thus, Muslim economic thought greatly enriched the Hellenic contribution to economic thought (oikonomia) and in the areas of government of the kingdom by the caliph, of the city, and the household organization.⁹

Because of the status of the church, and because it was the only source of any intellectual activity, medieval economics grew out of the Church. Their views on economics were gleaned from several sources — Aristotle, the bible, Roman law, and canon law as revived by Muslim scholars some of whom have been discussed above. Thus, medieval economics was a product of the clergy — in particular a group

⁹ The succeeding discussions had drawn heavily from Ekelund, Jr. and Hebert (1997) and Reynolds (2000).

of learned writers now referred to as the Scholastics — a term that generally means "professors" or "teachers."

Scholastic economics is not held in high regard. It is commonly perceived as a tissue of misplaced fallacies about market price, interest and property. Yet, they did hold some ideas of value that may be traced to later developments, but for the most part, they were concerned with justice and salvation. Thus terms such as "just price," came into wide usage, as well as their idea that charging interest for the loan of money was wrong.

Most of the references during this early period were to the economic conditions of the time. There were certainly great thinkers and great philosophers, but there was no common thread — no systematic analysis of the issues in their writing. Also, this was a period of a relatively simplistic economic system. The feudal system characterised by (i) very little trade outside the community; (ii) home production and consumption (subsistence); (iii) money and credit were not widely used; and (iv) there were no nation-states. So, it did not offer much for intellectual discussion.

It was one in which the land was owned by the king, and he donated it in large portions to his foremost noblemen. There was no absolute ownership — merely a right to use the land. In return, the nobleman had to pledge his services to the king — military; personal; labour; and produce. Government functions were vested in feudal lords, who reigned supreme within their limited domains. However, no matter how slow, every society evolves and so the world beyond feudalism was emerging perhaps unnoticed.

In the economic sphere, it is possible to discern roughly four themes the Scholastics were particularly concerned with, namely, property, justice in economic exchange, money, and usury. The growth of commerce forced the Scholastics to deal with the impact of market exchanges. They identified the "just

price" as that which supported the continued reproduction of the social order. The coexistence of private property with Christian teachings was never comfortable. This notwithstanding, in the fifth century, the early Church fathers (the Patricians, such as Augustine) had struck down "communistic" Christian movements and the Church itself went on to accumulate enormous amounts of property (see New World Encyclopedia).

Mercantilism

Mercantilism reigned (about 1500 – 1800 or 1776) and was practised throughout Western Europe. The mercantilists were the English "Pamphleteers" of the 16th, 17th, and 18th centuries rather than a school of thought. They showed no awareness of contributing to any definite stream of ideas. They had neither principles nor common analytical tools. But still, there were doctrinal threads that appeared again and again focused on power.

Mercantilists were generally merchants supported by some government officials, who gathered vast amounts of trade data and used it considerably in their research and writing. So, Mercantilism was the product from the assorted pamphlets, studies and treatises of these groups of practitioners. They had no systematic, comprehensive, consistent treatise, no leader, common method, or theory; each "mercantilist" sought advantage for a specific such as trade, merchant, joint-stock company or social group. "Protectionism" is often seen as a primary characteristic of Mercantilism. The primary objective of Mercantilism was to increase the power of the nation state. One of the important aspects of national power or strength was wealth that was equated with specie (precious metals especially gold and silver). The states that followed a policy of mercantilism

tended to see trade, colonialism and conquest as the primary ways of increasing wealth.

Most Mercantilists were practitioners, not theorists or analysts — particularly the early ones. Later ones were less so. Mercantilists were not so much concerned with justice and salvation, as were the scholastics. They were real world oriented may be because they are largely merchants and government officials rather than theologians and philosophers. Their writings were oriented toward policy applications that would be favourable to themselves. But, the writings were not thought out on any sound and logical theoretical or analytical framework. Many of them took the form of special pleadings and/or rent seeking undertones. Nevertheless, some economic thinking or theorizing was implicit.

It was the economic theory and practice common in Europe from the 16th to the 18th century. It promoted governmental regulation of a nation's economy for the purpose of augmenting state power at the expense of rival national powers. It was the economic counterpart of political absolutism. It was, in essence, economic absolutism. Its 17th century publicists, most notably Thomas Mun (1571-1641) and William Petty (1623 – 1687) in England; Jean Baptiste Colbert (1619-1683) in France, and Antonio Serra in Italy, never used the term Mercantilist to describe themselves. The name Mercantilists was given to them by the Scottish moral philosopher and economist named Adam Smith in his *Wealth of Nations* (1776).

A Mercantilist Manifesto by Philipp Von Hornick was developed in 1684. The points are

- Extensive use of the soil to produce agricultural products.

- All commodities found in the country that cannot be used in their natural state should be worked up within the country.
- Promote large population.
- Gold and silver should not to be taken out of the country.
- Inhabitants should make every effort to get along on their domestic products.
- Foreign products to be obtained in exchange for domestic goods, not gold and silver.
- Goods should be imported in unfinished form, then worked up within the country.
- Seek opportunities to sell the country's superfluous goods to foreigners in manufactured form.
- Allow no imports of which there is a sufficient supply of suitable quality at home.

Mercantilism's Interlocking Principles included

- Precious metals, such as gold and silver, were deemed indispensable to a nation's wealth.
- If a nation did not possess mines or have access to them, precious metals should be obtained by trade.
- It was believed that trade balances must be "favourable," meaning an excess of exports over imports.
- Colonial possessions should serve as markets for exports and as suppliers of raw materials to the mother country.

- Manufacturing was forbidden in colonies, and all commerce between colony and mother country was held to be a monopoly of the mother country.

The anti-liberal mercantilist philosophy was the dominant economic policy in the 16th to 18th centuries. Between 1600 and 1800 most of the states of Western Europe were heavily influenced by mercantilism policies. It gave rise to unfair international trade and the parasitic nature of the colonial powers. On the other hand, mercantilism can be seen as the struggle of feudalism to remain relevant despite the evolving new world order. Since, it is arguable that the most important economic rationale for mercantilism in the sixteenth century was the consolidation of the regional power centers of the feudal era.

The Dictates of Mercantilism included:

- Human wants were to be minimized, especially for imported luxury goods since they drained off precious foreign exchange.
- Sumptuary laws (affecting food and drugs) were passed to ensure that wants were held low.
- Thrift, saving, and even parsimony were regarded as virtues. Only by these means could capital be created.
- In effect, mercantilism provided the favourable climate for the early development of capitalism, with its promises of profit.

In Mercantilists writings certain concepts and theories did crop up, which they seemed not to appreciate, understand or follow very well, some of which are highlighted below.

The Specie Flow Mechanism

- The so-called specie flow mechanism was the “fly in the ointment” for the Mercantilist.
- Mercantilists did not believe or understand the specie flow mechanism.
- How does the specie flow mechanism upset the Mercantilist applecart?
- What is the Specie Flow Mechanism?
 - Inflow of gold — raises domestic prices.
 - Higher prices made imports attractive, domestic goods unattractive, and therefore more difficult to export.
 - Thus, selling dear and buying cheap tends to increase imports and decrease exports, which in turn, creates an unfavourable balance of trade against a country.
 - To pay for this unfavourable balance of trade, the country loses specie —not what you want to do if you are a Mercantilist!
 - Some Mercantilists realized this, example, Thomas Mun ((1571-1641)) realized it in 1630, still he was a Mercantilist.

Views on the Specie-Flow Mechanism

- Thomas Mun recognized the specie-flow mechanism but did not appreciate its long term implications.
- Other writers failed to understand the inconsistency between specie-inflow and price stability.

- Mercantilists sought to maintain a trade surplus as a way to enrich the country.
- Because of the specie-flow mechanism, a long term surplus cannot exist.
- In 1690, John Locke made perfectly clear that prices vary in proportion to the quantity of money, but in general, the Mercantilists did not put this together.

The Quantity Theory of Money

The quantity theory of money caused quite a dilemma for the Mercantilists. The quantity theory of money is explained in terms of the equation of exchange as expressed below.

$$MV = PT$$

The left hand side of the equation of exchange is the money supply and the right hand side the value of output produced in the economy over a period of time, say a year. There is some controversy over whether Mercantilists equated money with wealth. Some writers such as Thomas Mun and John Locke have maintained that wealth consists of more than gold, i.e., land, houses, etc. But even they slipped away from these ideas.

Also, the Mercantilists confused a nation with a family - the old fallacy of composition. For a family to accumulate wealth, it must spend less than its income. It must accumulate a surplus over consumption and the Mercantilists thought this is true of a nation as well.

Leading Features and tenets of Mercantilism

- Maintaining a surplus in the balance of trade and accumulating gold were the keys to prosperity.

- Bullion and treasure were the essence of wealth.
- Regulate foreign trade to produce inflow of specie.
- Promote industry — import cheap raw materials.
- Promote colonialism.
- Place heavy tariffs on imported manufactured goods.
- Encourage exports of manufactured goods.
- Increase population and keep wages low.

Mercantilism in France

- Luxury products like silks and linens tapestries, furniture, wines, etc were of major importance.
- Close regulation in the production of these goods was essential to maintain high quality.
- Under Jean Baptiste Colbert, Minister of Finance under Louis XIV, national guilds were set up to regulate major industries.
- Only craftsmen who were guild members could operate, and they were subject to regulation by the national organization.
- The royal power, supported by steady revenues from the salt tax, was strong enough to enforce regulation.
- Guilds remained powerful until the French revolution.
- In France, mercantilism was referred to as Colbertism.

Mercantilism in England

- In England, regulation of domestic industry was not successful because government was always short of

money. (The salt tax did not work for Elizabeth as it had for the Louis'.)

- English Mercantilists were devoted primarily to expansion of trade and encouragement of manufacture. The result was that: medieval guilds disintegrated, especially when cloth production developed in rural areas.
- Industrial processes were far freer of restrictions than were those of France.
- When Industrial Revolution began in late 18th century, absence of guilds gave English industry a huge head start over France.

Mercantilism in Germany

- German mercantilism resembles in many ways that of the French.
- Called Cameralism, it was originally concerned with problems of royal finance, taxation, and spending.
- Very authoritarian political tendencies. Very little development of democratic institutions in countries where it was practiced.
- Clear relationship between Cameralism of the 16th century and the rejection of classical laissez-faire in the 19th century.
- Pattern was set for a protectionist and institutional evolution of economic theory and action.
- We would see this trend if we went into the German Historical School.

- Von Hornick quoted earlier is one of two writers that illustrate their thinking.

Historically, Mercantilism is associated with the rise of the “Nation state.” Feudal institutions were weakened by the increasing use of money and a greater reliance on exchange within the economy and the Plague (The "Black Death" of 1346-61). Increasing use of money in the economy reduced the role of barter and reciprocity, people wanted to sell or work for money. Population of England fell by about 1.5 million (out of a population of 5 to 3.5 million in 1346). The result was not only more money per person (higher per capita income) but also more animals, land and goods per person, and prices fell. Labour shortage pushed wages and earnings up. Less people with increased agricultural production (some problems with harvests and animals dying), but on average, diets improved. Labour became more mobile; masters on feudal estates had to "hire" labour. This led to the rise of "free" labour. If you couldn't hire workers, then you rent the land to others. Small farms with limited labour shifted to pasture and sheep rather than tilling the soil.

The Protestant Reformation weakened the role of the church and consequently the civil role of the state was expanded. There was a rise of Humanism (the concern for well-being of humans in the short term). The decline of feudalism was also influenced by changes in technology in many dimensions such as the rise of mechanical power (water, wind) used in textile and mining; mechanical clocks, gunpowder, mechanisms and instruments, etc increased skills of craftsmen who made machines. All these spurred the “enclosure movement” and the commercialization of agriculture; rise of markets and fairs; urbanization; improvements in navigation, shipping, transport, moveable type, (standardization, mass production and marketing of

books in a variety of languages)¹⁰ all helped the evolution out of feudalism and from an agrarian into an industrial society. Mercantilism has been long overtaken by other Schools of Thought, but there are still modern day defenders of Mercantilist theory. Further, Mercantilist policies are still in vogue in particular in international trade and development economics.

Classical Economic Thought

Modern economic thought emerged in the 17th and 18th centuries as the western world began its transformation from an agrarian to an industrial society. But, this was preceded by a transformation from Mercantilism to Physiocracy in thought. Historically, the Physiocrats represented a reaction against the policies of Jean Baptiste Colbert [1619-1683], a Finance Minister in the Court of Louis XIV. Colbert advocated strict regulation of commerce, protective tariffs and is regarded as an archetypical “Mercantilist.” There were a number of writers who began to question the mercantilist policies of Colbert by the early 1700s (examples are Pierre Boisguillebert [1646-1714], Seigneur de Vauban [1633-1707] and later Richard Cantillon [1680-1734]), The Physiocrats represented an "alliance of persons, a community of ideas, and acknowledged authority and a combination in purpose, which banded them into a society apart", (Higgs, 2001). They held in common the idea that **all things are part of an interconnected system that is rational and comprehensible to the human mind.** However it was François Quesnay [1694-1774] – a Surgeon (anatomist) and medical doctor, who provided the basic structure of the Physiocratic system in the late 1750's in his *Tableau Economique* and other writings, many of which were published anonymously or under pseudo names.

¹⁰ See Reynolds, 200.

The Physiocrats, a group of 18th century French philosophers and economists opposed the Mercantilist policy of promoting trade at the expense of agriculture because they believed that agriculture was the sole source of wealth in an economy. They developed the idea of the economy as a **circular flow of income and output**. And as a reaction against the Mercantilists' copious trade regulations, the Physiocrats advocated a policy of **laissez-faire**, which called for minimal government interference in the economy. For this reason they are regarded as the early Classical economists.

The Early Classicists: The Physiocrats

The Physiocrats have been the subjects of so many and such divergent appreciations by historians, philosophers, economists, and students of political science, that hardly a single general proposition of importance has been advanced with regard to them by one writer which has not been contradicted by another (Higgs, 2001). To de Tocqueville they were doctrinaire advocates of absolute equality. To Rousseau they were the supporters of an odious, if “legal”, despotism. To Professor Cohn they were, in their main proposals, “thoroughly socialistic.” To Louis Blanc they were tainted with a bourgeois individualism. To Linguet their mystic jargon was charlatanical nonsense, not to be understood even by them. To Voltaire, physiocracy was so clear as to be made easily comprehensible (and ridiculous) to the meanest intelligence. To Taine, as to many others, they made powerfully for revolution. To Carlyle, who speaks ironically of “victorious analysis” and scornfully of “rose-pink sentimentalism”, they seem to have been a mere literary ripple on the surface of the great flood.

Rossi praised them for conceiving a vast synthesis of social organisation; certain writers, like Mably, have blamed them for a narrow materialism; while there are judges who

pronounce them markedly deistic. To Proudhon their system of taxation was a rare Utopia; to others they lack an ideal of any kind. They were to de Loménie a bundle of contradictions — at once monarchical and democratic, half-socialist and highly conservative. To Adam Smith their “system, with all its imperfections, is perhaps the nearest approximation to the truth that has yet been published upon the subject of political economy, and is, upon that account, well worth the consideration of every man who wishes to examine with attention the principles of that very important science.”

To many compilers of little text-books, who know better than Adam Smith, they are merely people who lived in the dark ages before 1776, and held some absurd opinions about land. To some they appear to have had a transitory success followed by complete and lasting reaction. To Léon Say their principles, after suffering reverses in the eighteenth century, have dominated the nineteenth. Of many serious writers, these anxious precedents, have appealed to their authority in support of their own views; those, striving after originality, have been eager to prove that the point which they seek to emphasize was really missed by the Physiocrats; and the great majority of authors have been content to follow the well-worn phrases of one predecessor or another without direct reference” to the writings of the old economists themselves. Probably no man alive has read the whole published works of, say, the Marquis of Mirabeau — to mention only a single member of the school. And happily no one is obliged to do so. When once we have mastered their doctrines we are dispensed from following the prolix repetitions and tedious amplifications which make up nine-tenths of their literary activity. Yet, mastery is essential to a due acquaintance with the history of economic theory. For the Physiocrats constitute the first scientific school of political economy.

The term physiocracy means law or rule of nature. Vaggi (1987) points out that the Greek word *phýsis* is nature and *krátos* is power. They believed that a natural system, free from the intrusions of an improper man made law, would result in a harmony and improvement of the human condition (*ibid. p 869, The New Palgrave Dictionary of Economics, edited by Eatwell, Milgate*). This is the essence of *laissez faire*. Physiocracy derives from a collection of essays by François Quesnay (1694-1774) edited by Pierre Samuel du Pont de Nemours and published in two volumes in 1767–1768 in which the name Physiocratic figures prominently. Quesnay was the uncrowned leader of what was perhaps the first school of thought in economics. The school was highly influential on economic policy matters in France in the period from 1756 to the beginning of the 1770s during the reign of Louis XV. Even more important, it had a decisive impact on the emerging new scientific field of political economy. The school's relatively small number of followers and their strict adherence to the teachings of Quesnay are presumably responsible for the school also being known as a "sect". The school's major members, apart from those already mentioned, were Abbé Nicolas Baudeau, Victor Riqueti, Le Mercier de la Rivière, and François Guillaume Le Trosne.¹¹

¹¹ See "On the natural law underpinnings of Physiocratic thought", (see Rieter (1983)) fFrom INTERNATIONAL ENCYCLOPEDIA OF THE SOCIAL SCIENCES, 2ND EDITION.

A key idea of Physiocracy was that agriculture (land or extractive industry which included grasslands, pastures, forests, mines and fishing [Vaggi, p. 871]) was the productive sector of an economy. The society was divided into landlords, farmers and artisans. Quesnay's *Tableau économique* is a model of the flows of commodities among the three sectors. Land is seen as the source of net product that may be regarded as a surplus. Trade and industry perform a function but were seen as sterile in that they produce no net product. The manufacturing sector is "sterile" because, while it uses part of the net product of the agricultural sector and transforms it into some other goods, it does not add to the (value of the) net product (Meek 1962; Pressman 1994 cited in Higgs, 2001).

As a reaction against the extreme mercantilist policies of Colbert, the Physiocrats advocated *laissez faire* policies. They believed that if the positive order or rule of man could be made consistent with the order of nature (not to be confused with the state of nature), the well being of society could be increased. Given the complex and high levels of taxation of Louis XIV, one of the proposals was a single tax on land.

Core Beliefs¹²

The Physiocrats believed in the existence of a "natural order," or *ordre naturel*. They appealed to rational principles in the tradition of a "Cartesian" perspective. The cosmos was seen as a hierarchically and harmoniously arranged order. There was a distrust of "data", "positive" law and human behaviour. The social order, "order positive" should be consistent with the "natural order". The Physiocrats "deduced" a connected series of doctrines based on premises and

¹² This has benefitted substantially from Reynolds, 2000.

endeavoured to include all social phenomena connected with the production of wealth.

The natural order was not to be confused with state of nature. It was founded on law and property rights. Physiocrats denied that every one has a right to everything: “A Bird has a right to an insect that it can catch.” They believed that liberty and equality were incompatible. As a society grows wealthier, inequality increases. Men in society are subject to natural laws in the same way that the equilibrium of nature is maintained by physical laws.

The Physiocrats saw the interrelation between physical and social phenomena, but at that time physics and biology were not highly developed in modern sense.

There was an emphasis on the individual and individual rights. It was believed that the individuals know their interests and will act on those interests. The principle idea embedded in Physiocracy is that of “self interest” as the motivating force in the economy. The rights of each individual limited the rights of others. “Freedom of the foolish man must be restricted by the state.”

Agriculture was the fundamental industry of the country; liberty and security were its chief requisites. Agriculture and commerce are regarded as the two resources of wealth in France; but this distinction is, the Physiocrats believed, a mere abstraction, for commerce and industry (which is much more considerable than commerce) are but branches of agriculture, — the primary and indispensable source of the other two.

The Physiocrats believed in free trade and on their recommendation in 1763 and 1764 the corn trade, both domestically and abroad, was liberalised in France. But the second half of the 1760s saw substantial increases in the price of corn, which the public took to have been caused by the liberalisation policy. However, there is reason to think that the

price increase was the result not so much of grain exports as a series of bad harvests (see International Encyclopedia of the Social Sciences, 2nd Edition). The experiment was terminated in 1770, and since its failure was blamed on the physiocrats, it comes as no surprise that their influence declined as quickly as it had risen (Weulersse 1910; Hecht 1958). In other countries the ideas of Quesnay and his followers (the Physiocrats) remained important, at least for a while, including especially Germany and Russia.

Classical School of Scientific Political Economy¹³

Strictly and generally speaking, economic thought as it has evolved so far is as political economy provided the ideas are weighed sympathetically in the context of the times in which they developed. So, perhaps the difference between the past and the time of the Classical School is the development of scientific political economy. The prefix "classical" is used to denote the adoption in the late eighteenth century of an approach which was inspired by the enlightenment and the methodology of the **physical sciences**, and which abandoned previous tendencies to examine the subject in the context of ethics, religion and politics, ("History of economic thought", Citizendium (2009)). It was the tendency to examine the subject in the context of ethics, religion and politics that made economics look like a moral science. Classical economics is widely regarded as the first modern school of economic thought. The Classical School of economics was developed about 1750 led by Adam Smith and lasted as the mainstream of economic thought until the late 1800's. Strongly opposed to

¹³ Even Adam Smith regarded the political economy of the physiocrats as scientific (see Higgs, 2001, p. 6). This, however, is disputed by Stigler (1982), who believes that the scientific age of economics started with Adam Smith and his *Wealth of Nations*. There are, of course, many who don't even think that there are sciences outside the natural sciences such as Luskin (2008).

Mercantilist doctrines, it was influenced by Physiocracy, the British enlightenment, classical liberalism, capitalism and the early stages of the industrial revolution, the work of David Hume and the methodology of the physical sciences.

Nineteenth- and early twentieth-century economists applied deductive reasoning to axioms considered to be self-evident truths, and to simplifying assumptions which were thought to capture the essential features of economic activity. That methodology yielded concepts such as elasticity and utility, tools such as marginal analysis, and theorems such as the law of comparative advantage. An extension of the relationships governing transactions between consumers and producers was considered to provide all that was necessary to understand the behaviour of the national economy. Interestingly enough, the creator of the term was Karl Marx, and it was further perpetuated by John Maynard Keynes in his *The General Theory of Employment, Interest and Money* published in 1936.

On the other hand, historians categorise economic thought into “periods” and “schools”, and tend to attribute each innovation to one individual or a group. That is helpful for the purpose of exposition, although the reality has been a story of interwoven intellectual threads, crossing some categories and often persisting through all of them (mercantilism is a good example); and in which advances attributed to particular individuals have often been prompted by the work of others. For example, the quantity theory of money, that achieved prominence in the twentieth century and is associated with the name of Milton Friedman, was first formulated at least three centuries earlier. Many of those threads - such as the concept of value and the nature of economic growth - that have permeated the categories referred to as "Classical economics" and "Neoclassical economics", had

an earlier origin in Pre-classical economics (see Citizendium, 2009).

Admittedly, Political Economy became an integrated body of knowledge and a separate discipline in 1776 with Adam Smith's monumental work, *The Wealth of Nations*. For this reason Adam Smith is often regarded as the father of modern economics though some economists would wish to give the title of founder of economics to earlier writers such as Cantillon (Stigler, *ibid.*). A major advance in the development of economics occurred with the publication in 1776 of Adam Smith's *An Inquiry into the Nature and Causes of the Wealth of Nations*. It was a comprehensive treatment of the subject, using deductive logic in a similar way to its use in the physical sciences. Its main purpose was to recommend changes in economic policy in the interests of economic growth.

Adam Smith argued that the division of labour was the main cause of economic growth, and that government intervention in commerce was its main impediment. He advocated government spending upon what are now termed public goods such as defense, law enforcement and infrastructure, and upon the education of the children of people who could not afford it – and, by implication, upon nothing else. He identified what he considered to be the economic drawbacks of all forms of taxation (except the taxation of land values) and of the deficit financing of public expenditure. He examined the relationship between price and value and concluded that the “natural price” of a product was the same as its cost of production, and that divergences from it would eventually be bargained away. Adam Smith is thought to have got many of his ideas from his friend David Hume and from conversations with the French Surgeon and economist, Francois Quesnay (and his fellow "Physiocrats"), but he had a far greater influence upon economic thought. Political economy reached maturity in the works of Jean-Baptiste Say,

the Rev. Thomas Malthus, David Ricardo, Jeremy Bentham and John Stuart Mill. Sometimes the rank of the classical economists is expanded to include William Petty¹⁴, Johann Heinrich von Thünen, A. C. Pigou, Alfred Marshall and even Karl Marx. In fact, Keen (2003) even asserts that a dialectical interpretation of Marx provides a foundation for a viable rival to neoclassical economics.

The theories of the classical school were mainly concerned with the dynamics of economic growth. Reacting against mercantilism, classical economics took many of its cues from its predecessors while clearing contradictions and correcting recognised fallacies. Central to the theory were economic freedom, competition, and laissez-faire (limited) government. The idea that economic growth could best be promoted by free trade, unassisted by government, was in conflict with mercantilism. According to Marshall classical economics was cogent and logically correct. While its assumptions encompassed many broad and challengeable generalisations, its sweeping logic was elegant. Few episodes in the history of economic thought match the achievements of the classical economists in discovering and formulating the operations of an entire economic system. In addition, they established the method upon which modern economic reasoning is based. Although the assumptions of classical economics were in fact simplistic, the goal of the classical economists was nothing less than global analysis of entire economies. One might legitimately wonder whether such large ends would or could be sought by contemporary economists. "Progress" and the quest for technical accuracy have probably robbed us of the wit, but the classical theoretical structure remains as an inspiration for such an attempt.

¹⁴ Reynolds (2000) thinks that William Petty is the bridge between the Physiocrats and the Classical School.

The *Wealth of Nations* identified land, labour, and capital as the three factors of production and the major contributors to a nation's wealth. In Smith's view, the ideal economy is a self-regulating market system that automatically satisfies the economic needs of the populace. He described the market mechanism as an "invisible hand" that leads all individuals, in pursuit of their own self-interests, to produce the greatest benefit for society as a whole, sometimes called the "harmony theory". Smith incorporated some of the Physiocrats' ideas, including laissez-faire, into his own economic theories, but rejected the idea that only agriculture was productive. While Adam Smith emphasized the production of income, David Ricardo focused on the distribution of income among landowners, workers, and capitalists. Ricardo saw a conflict between landowners on the one hand and labour and capital on the other. He posited that the growth of population and capital, pressing against a fixed supply of land, pushes up rents and holds down wages and profits.

Thomas Robert Malthus used the idea of diminishing returns to explain low living standards. Population, he argued, tended to increase geometrically, outstripping the production of food, which increased by arithmetic progression. The force of a rapidly growing population against a limited amount of land meant diminishing returns to labour. The result, he claimed, was chronically low wages, which prevented the standard of living for most of the population from rising above the subsistence level. Malthus also questioned the automatic tendency of a market economy to produce full employment. He blamed unemployment upon the economy's tendency to limit its spending by saving too much, a theme that lay forgotten until John Maynard Keynes revived it in the 1930s. Malthus was in a search for general theory of value and valid methods in economic analysis.

Coming at the end of the Classical tradition, John Stuart Mill parted company with the earlier classical economists on the inevitability of the distribution of income produced by the market system. Mill pointed to a distinct difference between the market's two roles, namely, allocation of resources and distribution of income. The market might be efficient in allocating resources but not in distributing income, he wrote, making it necessary for society to intervene. In the late 18th century, Jeremy Bentham developed the theory of 'Utilitarianism,' which was introduced into Economics through the writings of John Stuart Mill, which shaped economic thinking. It is still very much an integral part of modern economic theory at the introductory levels, at least.

Heterodox Economics

We shall treat all the other schools of thought as coming under heterodox economics to refer to all that are considered outside of classical orthodoxy. Thus, heterodox economics is an umbrella term used to cover various separate unorthodox approaches, schools, and/or traditions. These include Marxian, neo-classical, institutional, Keynesian, monetarism, post-Keynesian, feminist, Austrian, ecological, environmental and social economics among others.¹⁵ The views of these schools may be contrasted with the framework used by the majority of economists, commonly referred to by its supporters as mainstream¹⁶ and by critics as orthodox. This framework consists of the neoclassical synthesis, which combines a neoclassical approach to microeconomics and

¹⁵ It is beyond the scope of the lecture to traverse all the known schools of thought, traditions, approaches and methodologies in economics given the very important space considerations. As it is said earlier, the focus is on some crucial moments in the development of economic ideas.

¹⁶ To many, mainstream economics may be synonymous with neoclassical orthodoxy and should not be under heterodox. But, it is here so accommodated as a refinement on Classical economics.

Keynesian approach to macroeconomics, with varying degrees of emphasis.

Marxian Political Economy

Can Karl Heinrich Marx (1818–1883), a revolutionary, social thinker and economist be considered as a representative of the classical school? Marxian theory is the political economy of growing social conflict which challenged and critiqued the foundations of Classical economics, what he called Capitalism. Marx adopted the Ricardian labour theory of value and worked out all of its logical implications focusing on laws of the dynamics of capitalism. He combined it with the theory of surplus value to examine society and argued that the wealth of capitalists was based on paying labour less than their true labour value (underpaid labour), which is the sole source of profits (surplus). This difference between the true labour value and the wages paid led to the accumulation of money capital. Consequently, Marx held that revenues of production belonged to labour, and the surplus value or profits, properly belonged to workers. For this reason, and due to an army of unemployed workers which keeps wages low, capitalists exploit workers. However, as capital goods accumulate, the rate of profit will fall, and industry will become more concentrated in ownership. Eventually, the proletariat would revolt and own the means of production, sharing the product first according to contribution (Socialism) and ultimately according to need (Communism). Marx believed that capitalism suffered a set of internal contradictions in its very philosophy which would eventually cause it to collapse.

In sum, Marx argued that Capitalism was inherently unstable because:

- Workers were abused and disenfranchised. As capitalism developed, Marx predicted, workers would

become increasingly alienated and seek to overthrow the capitalist class.

- Capitalists could make bad decisions about what to produce.
- Growth was not guaranteed but could become volatile leading to periods of economic slump. Marxists certainly point to the Great Depression as a vindication of how capitalism can fail.

Modern Marxist economists follow Marx's general line of thought, with various modifications. Despite the failure of socialist systems and the theoretical criticism of Marxist thought, Marxists continue to believe that the market process (Capitalism) is inherently flawed and needs much fixing.

Marginalist Revolution and Neoclassical Economics

A number of heretics quickly arose from the church of classical economics (Burtini, 2009). They range from the Marxians to the Keynesians and everything in-between, a beautifully impressive body of competitive works have defined, redefined and re-redefined what economics is, and all of its basic tenets. Marx's criticism of capitalism; Malthusian rejections ("gluts", the foundation of Keynesian theory) and the French rejections of classical economics - subjects that are too vast to address in this lecture became the foundation of neoclassical economics at about 1870. The newly founded London School of Economics became a competitive, driving force against the U.S. based Chicago and Cambridge schools of economic thought, each providing its own new contribution to economics and dividing the field in to a number of diverse theories.

The economists of the English historical school were in general agreement on several ideas. They pursued an inductive

approach to economics rather than the deductive approach taken by classical and neo-classical theorists. They recognized the need for careful statistical research. They rejected the hypothesis of "the profit maximizing individual" or the "calculus of pleasure and pain" of the homo economicus as the only basis for economic analysis and policy. They believed that it was more reasonable to base analysis on the collective whole of altruistic individuals. They also rejected the view that economic policy prescriptions, however derived, would apply universally, without regard to context – place or time, as followers of the Ricardian and Marshallian schools did.

Marginalist Revolution (1871-1874)

Marginalism refers to the use of marginal concepts within economics – (marginal concepts are associated with a specific change in the quantity used of a good or service, as opposed to some notion of the over-all significance of that class of good or service, or of some total quantity thereof, (Wikipedia)). In practice, marginalism actually refers to making very small changes at a time in quantities or variables under reference and study to see the effects of such small changes. It connotes analysis of incremental changes, where the increments could be infinitesimally small. The dating of this "revolution" is commonly ascribed to 1871-74, when the concept of diminishing marginal utility was introduced by William Stanley Jevons, Carl Menger and Léon Walras, to pin down the character of demand -- thus the term "Marginalist".

The fathers of the marginalist revolution are William Stanley Jevons (1871), *The Theory of Political Economy* (England), Carl Menger (1871), *Principles of Economics* (Grundsätze), and Leon Walras (1874), *Elements of Pure Economics* (Switzerland). But their precursors include Thomas Malthus (1814), George von Buquoy (1815), Perronet Thompson (1824), Augustin Cournot (1838) and Charles Ellet

(1839), (see Cunningham, 2006). Cunningham regards them as marginalists before Alfred Marshall. They sought to apply calculus, physics and engineering methodologies to economic analysis. They disproved the labor theory of value and believed that the marginal principle provides a unifying framework and placed less emphasis on growth, while focusing on optimization, equilibrium and mathematical methods with concentration on economic science. They recognized the need for careful statistical research for purposes of verification of their hypotheses.

The central concept of marginalism proper is that of marginal utility, but marginalists following the lead of Alfred Marshall (1842–1924) were further heavily dependent upon the concept of marginal physical productivity in their explanation of cost; but the neoclassical tradition that emerged from British marginalism generally abandoned the concept of marginal utility and gave marginal rates of substitution a more fundamental role in consumer theory and theory of the firm.

The Method of the Marginalists included marginal principle with emphasis on microeconomics; abstract, deductive method; assumption of perfect competition; less emphasis on supply, more on demand in price setting; subjective valuation; equilibrium approach; equal footing for all factors of production; rational agents; minimal government intervention. For the theory of the firm, they used the applications of calculus, physics (thermodynamics, formalism of energy physics and the maximum principle) and engineering principles and methodologies to economic analysis. Their theory of monopoly was built on the hypothesis that each person seeks the greatest value from his/her property or labor until it reaches the competitive case. The labour theory of value is disproved believing that the marginal principle provides a unifying framework. They put less emphasis on growth and focused on optimization (interpreted to be the best

in any given situation), equilibrium and mathematical methods as applicable to economic science.

The marginalists were highly formal and mathematical in their analysis. For example, in 1814, Malthus mentioned that differential calculus might be useful in economics; in 1815, George von Buquoy applied the calculus to an agricultural problem; in 1824, Perronet Thompson became the first writer among English economists to use calculus in economic analysis; Johann Heinrich von Thünen (1783 - 1850) was a prominent nineteenth century economist and (north German) landowner, who in the first volume of his treatise, *The Isolated State* (1826), developed the first serious treatment of spatial economics, connecting it with the theory of rent. Its importance lies less in the pattern of land use predicted than in its analytical approach. Von Thünen also developed the basics of the theory of marginal productivity in a mathematically rigorous way, summarizing it in a formula.

Antoine Augustin Cournot (1801-77) in 1838, published *Researches into the Mathematical Principles of the Theory of Wealth* in which he applied mathematics to profit maximization in competition, monopoly, and duopoly resulting in the equilibrium condition, MR (marginal revenue) = MC (marginal cost). His theory of duopoly is the precursor of non-cooperative game theory, i.e. duopolists act in anticipation of the opponent's action working with reaction curves that produced equilibrium that lies between monopoly and competition solutions. His is regarded as the first systematic development of the application of the marginal principle to the theory of the firm using mathematical economics of the "pure" type approach that was consistent with French 'Rationalism' – a theory that reason is in itself a source of knowledge superior to and independent of sense perceptions; and supply and demand. They worked with the hypothesis that each person

seeks the greatest value for his/her property or labour. In 1839, Charles Ellet used the calculus to determine an optimal tariff.

Philip H. Wicksteed (1844-1927) developed a theory of marginal productivity and distribution. He alone asked whether and under what conditions the total product would be exhausted by the marginal products and provided the answer in Euler's Theorem, namely, $TP = \sum_i x_i MP_x$, where TP is total

product, MP_x = marginal product of input x and x_i quantity of input i. He argued that exhaustion of the marginal product requires a linear homogeneous production function. Wicksteed also argued that this requires constant returns to scale (i.e. if you double the inputs (materials) output also doubles) in his 1894, *Essay on the coordination of the Laws of Distribution*. Francis Ysidro Edgeworth (1845-1926) wrote many articles and a monograph entitled *Mathematical Psychics* in (1881). He sought to apply mathematics to the social (moral) sciences and expanded Jevons notions on the utility function. He introduced indifference curves and the Edgeworth box that are prominent in the ordinal utility theory of consumer behaviour and international trade theory. Alfred Marshall published his *Principles of Economics* in 1890 (1st edition), 1920 (8th edition). He was a marginalist who not surprisingly used mathematical framework.¹⁷ Yet, he wrote for the intelligent layman putting graphs in footnotes and mathematics in appendices and used biological rather than mechanical/mathematical, analogies for examples. Marshall is regarded as the bridge between the marginalists and the neoclassicals.

¹⁷ Alfred Marshall was a mathematician

Neoclassical Economics (1875 – 1890)¹⁸

The term was originally coined by Thorstein Veblen in 1900, in his “Preconceptions of Economic Science”, to distinguish marginalists in the tradition of Alfred Marshall from those in the Austrian School. Given the prefix “Neo” in the expression “Neo-Classical Economics”, it is not clear if it is suggestive that today’s prevailing economics is a continuation or a new edition of Classical Economics. Neoclassical economics is a term variously used for approaches to economics focusing on the determination of prices, outputs, and income distributions in markets through supply and demand, often as mediated through a hypothesised maximization of income-constrained utility by individuals and of cost-constrained profits of firms employing available information, technology and factors of production, in accordance with rational choice theory.

There seems to be some confusion over the origins of neoclassical thought. It might be due to the fact that it developed at the time of the Marxian criticism of Capitalism with rising socialist ideas in Europe. There were of course, the French rejections of classical thought and the development of the marginalist revolution. For these reasons it is believed in some quarters that the response to Marxian and other rejections of classical economics and the methodology of the marginalists became the foundation of neoclassical economics in about 1870. Thus, the term "neoclassical" is commonly applied to all of the continuing developments in economic thinking that followed the **replacement of value-based concepts** by a systematic consideration of the behaviour of markets that are governed by the interaction of supply and demand (Marshallian economics). In that sense, the term

¹⁸ For some this the mainstream economics orthodoxy, (see Peter Monaghan, <http://chronicle.com/free/v49/i20/20a01201.htm>)

denotes a period rather than a consistent approach, although it is a period that overlaps the competing approaches of Keynesianism and monetarism.¹⁹ It is nevertheless a period in which most economists have deduced their findings from the same hypothetical postulates - including the assumption of competitive markets in which consumers maximise utility and producers maximise profits subject to constraints, and which interact so as to constitute a stable, coherent and predictable system that is now known as the "neoclassical model". Within that framework of postulates, neoclassical economists have explored a variety of aspects of economic activity in a variety of different ways.

The neoclassical period is also marked by an expansion in the number of people applying their minds to the problems of economics, as a result of which there frequently have been similar contributions from a number of different thinkers. Consequently, there has been a confusion regarding the origins of neoclassical economics. Some writers date it from 1871 to imply that it was started by the marginalists and hence the conclusion that it is a natural outgrowth of the marginalist revolution or even of natural outgrowth of those themes already present in classical economics (e.g., in the works of Adam Smith and David Ricardo) and French economic thought (e.g., in the enterprises of Cournot), (see Blaug (1978: 322)). Others end it in 1890, when it is supposed to have begun with Marshall's publication of the *Principles of Economics*.

The "Marginalist Revolution" concerns the discovery of marginal utility theory, which occurred in the 1870's. It embodies the birth of neoclassical economics. However, there are four main motivations for an examination of the origins of neoclassical theory. The first is romantic, concerned with tracing the intellectual background of this innovation. The

¹⁹ Though, monetarism in a sense is an innovative revival of classical economics.

second pertains to an interest in the methods of celebrated discoverers, to provide a model for currently accepted methods of research. The third motivation is of practical importance. For instance, the theoretical suggestions around the time of marginalist revolution may serve to prompt novel contemporary lines of inquiry that may have possibly been clouded by modern theory. The fourth arises from the curious circumstances surrounding the marginalist revolution. For example, William Stanley Jevons once asserted that marginal utility theory had been independently discovered three or four times before.

Equilibrium and the Price Mechanism

The concept of market equilibrium is central to the neoclassical model. Leon Walras thought of it as the achievement of an imaginary auctioneer who adjusts a notional opening price in response to a succession of bids by buyers and sellers, and permits transactions to take place only when a price is reached at which buyers are willing to buy all that is offered for sale. That is, the process of price determination by supply and demand which marks the abandonment of the concept of value-determined price, and which is examined in detail in Marshallian Economics and in Milton Friedman's Price Theory. Walras, and subsequently the Italian economist Vilfredo Pareto, later developed the concept of a general equilibrium in which supply is equal to demand in every market simultaneously in a closed economy. The normal assumption of neoclassical economics is that of a stable equilibrium to which the economy will automatically return after a disturbance. In particular, unemployment cannot persist because any excess in the supply of labour, relative to its demand, is corrected by a reduction in wages.

Welfare and Efficiency

The most politically influential of the contributions of the neoclassical economists was probably their development of the concept of welfare. In accordance with the precepts of representative government, they assumed the criterion for the success of an economic system to be the welfare of the individual, and they introduced the concept of economic efficiency as a measure of that success. Vilfredo Pareto took the lead in defining efficiency taking his cue from the concept of the efficient machine, as a state in which no-one could be made better off without making someone else worse off. Three types of efficiency were identified as productive efficiency (the production of good at minimum cost), allocative efficiency (the provision of the mix of goods that consumers want) and distributive efficiency (the distribution of the goods and services in such a way as to maximise individual and social welfare). That work laid the foundations for the subsequent development of the theory of welfare economics by Sir John Hicks and others. (The subject of economic welfare is discussed extensively in Arthur Cecil Pigou's *Economics of Welfare*, and the theorems of welfare economics are summarised in William Baumol's *Economic Theory and Operations Analysis*.)

Competition

The theorems of welfare economics establish a presumption that allocative efficiency will be achieved - that is to say resources will be optimally allocated as between the production of alternative products - under the hypothetical conditions of perfect competition. (Those conditions include the requirement that for each product there is no supplier large enough to influence prices, that all producers supply identical products, and that all consumers are well informed and behave

rationally.) Despite the unreasonableness of these requirements, most economists advocate a presumption that restrictions upon competition will result in a reduction in efficiency - a presumption that is open to rebuttal, however, if economies of scale yield gains in productive efficiency that outweigh the loss of allocative efficiency. Those theoretical developments were the foundation for antitrust and other forms of competition policy, the economics and politics of which have been developed by George Stigler and other members of the Chicago School of Economics.

The theory of the firm

The tools of welfare economics were also used to develop the theory of the firm by Nicholas Kaldor of the London School of Economics in his *Equilibrium of the Firm* and Ronald Coase in his *The Nature of the Firm*. (These theoretical developments have been summarised in William Baumol's *Economic Theory and Operations Analysis*. An empirical study of the way firms actually behave is provided by Cyert and March's *Behavioral Theory of the Firm*)

Economic growth

There has been successive attempts to create models of economic growth that identify the contributions of such factors as investment, productivity, innovation and institutional environment that explain the differences in growth experienced by different nations and regions of the world. In the simple model proposed by Malthus in 1850, growth could not exceed population growth, but it was not long before it became evident that it was doing so. The *Harrod-Domar model* and its successors assume that there would be sufficient economic growth to enable some to go into growth-enhancing investments. In a later development, the 1956 *Solow model* introduced the influence of the substitution of capital for

labour resulting from investment in improved capital equipment. Solow also pioneered the technique of growth accounting, which he used to estimate relative contributions to historical growth in the United States in which he identified an unexplained residual, which he termed total factor productivity, the growth of which he attributed to technological change. Technological change was "exogenous" to the Solow model, in that it was not the consequence of factors that were represented in the model. As a result of subsequent research, notably that of Paul Romer and Robert Lucas, some of the factors believed to influence technological change, such as expenditure on research and development (R&D) and training, have since been embodied in the growth models, which are termed endogenous growth models. The most recent work on the subject has sought to identify the contributions to economic growth of institutional factors such as quality of governance, trust, and ethnic diversity; and to explore its links with geographical factors and globalization.

Besides Menger, two other economists, Stanley Jevons in Great Britain and Leon Walras in France pioneered marginal utility theory and thus sparked a revolution in economic thought that converted most economists from classical to neoclassical analysis. In neoclassical thought, the value of goods derives not from labor but from their marginal utility. The classical differentiation of land and capital became blurred, as neoclassical theory became increasingly described in mathematical terms. Land became treated as part of capital. Walras pioneered the theory of general equilibrium, with a model of an entire economy where all production is interrelated in an equilibrium setting all prices and quantities. Alfred Marshall in Great Britain developed the theory of supply and demand, including the geometrical conventions of the curves. In Sweden, Knut Wicksell, influenced also by Austrians, further developed theories of capital, interest, and

public finance. Favorable to taxing land, Wicksell originated the concept of the natural rate of interest in a free market.

The institutional school

While most economic theory is based on abstract supply and demand, factors, and expenditure, the institutional school points out that organisations also influence economic activity. The American economist Thorstein Veblen was a key theorist in this approach. Government, large corporations, banks, labor unions, and social organizations certainly affect the outcomes in economies, and institutional economics is important in the understanding of economic history and current economic life. The theory of institutions is also part of basic economic theory. Both the Austrian and neoclassical schools have included institutional concepts in their theories, including the role of central banks in Austrian monetary theory and the role of land tenure in neoclassical theory.

The Interventionist School and Keynesianism

When modern neoclassical economics failed to identify causes of the Great Depression, John Maynard Keynes stepped up with his publication, ***The General Theory of Employment, Interest and Money***, laying clear foundations for what modern economists refer to as “macroeconomics” coined in 1951 by Regnar Frisch. Keynes supported a number of beliefs, at the time exotic beliefs about what defined economics and how to properly analyze the Great Depression (the driving force behind Keynesian popularity) - much of Keynesian thought has been eliminated in the modern body of economic works, but, Keynesian philosophy still drives much of both neoclassical economics and political behavior internationally.

During the great world-wide depression of the 1930s, many neo-classical economists came to doubt the full-employment claims of neo-classical macroeconomic theory,

although Austrians and neoclassical economists recognized that the economies of the early 20th century had many interventions which had led to the depression. John Maynard Keynes (1936), tried to overturn many neo-classical concepts, although microeconomic neoclassical theory was not questioned. It seemed like neoclassical economics was not prepared for a phenomenon such the Great Depression or simply relied on “classical macroeconomics”,²⁰ as summarised in Say’s Law, namely, supply creates its own demand; rather than the correct Keynes Law – effective demand creates its own supply.

Keynes argued that wages would not automatically or swiftly adjust to a lower supply and demand juncture, but can remain stuck at a high level, reducing the demand for labor and creating unemployment. Also, Keynes disagreed with the classical and neoclassical concept that investment increases with lower interest rates. To Keynesians, markets do not necessarily work well, and they are not always self-correcting when unemployment rises and output declines. Government intervention is needed to boost demand. Whereas classical theory states that the supply side determines output, since factors are paid the full amount of the product, and since prices adjust to equilibrate supply and demand, Keynesian interventionists’ claim that prices and wages don't in fact adjust and that in a money economy, the total demand for products can be insufficient, since people don't necessarily spend enough.

Keynesian policy thus emphasizes increasing demand during a depression by increasing the money supply, by increasing government spending, raising the money supply, and reducing taxes to increase private spending. During a boom, the government can reverse these policies to reduce

²⁰ Not so conventional term.

inflation. Interventionists have restored some mercantilist policies, some arguing for protectionist measures.

Critics of such interventionist policies point out that the interventions, first of all, do not necessarily work in the long run. Inflating the money supply eventually raises prices and stops raising output, aside from distorting prices and production. Also, these policies attempt to treat the effects of economic problems without analyzing the root causes, which turn out to be interventions rather than the market process itself.

In response to these critiques, a New-Keynesian school has developed, with more sophisticated theories, how markets fail and how intervention can correct them, so the debate continues.

The New-Classical Macroeconomic School

In reaction to the interventionists, especially in money and banking, the monetarist school restored the classical theory of money that emphasizes the role of the quantity of money. High money expansion in the long run leads to inflation rather than increasing output. A key monetarist has been the late Milton Friedman in the United States. Monetarists point out that government does not have the information and knowledge to respond to every twist and turn in the economy, so instead of discretionary policy, it is better to have some rule that will be followed by central banks. Monetarism is not a complete macroeconomic theory, but is a school within macroeconomics, especially for monetary economics.

More comprehensively, some economists have argued against intervention as the "new classical" school. A key concept in this school is that of "rational expectations," which states that people create judgements about the future behaviour of economic variables such as inflation using past information and some model or theory of the economy, by which they will

avoid systematic mistakes. The New-Keynesian school has accepted rational expectations, so it is not an exclusively new-classical principle, but it is used to rebut some interventionist policies, since the new-classicalists state that people will recognize and respond to expected policy interventions.

The famous Milton Friedman in his *Monetary History of the United States 1867-1960* raised a further rejection of standard neoclassical economics, with regard to monetary policy and founded the creation of a new school - the Monetarist school, concerned mostly with the theories of money supply, national income, and central banking. Monetarists advocate a central bank with policies which aim to keep the supply of and demand for money at equilibrium - that is, focus on price stability rather than using floating interest rates to inject and withdraw money at more arbitrary cycles. This is defended by the claim that inflation is directly correlated to the money supply, and that a creation of more money without an equal creation of productivity would reduce the (unmet) demand for money, and thus drive down its value.

The post-Keynesian school

A new macroeconomic school of thought based on Keynesian thought, expanded by the work of the Polish economist Michael Kalecki, has been called "post-Keynesian." They follow Keynesians in believing that markets don't always clear and that individuals don't always perceive the correct market signals. They also have adopted some institutionalists' thoughts and the Marxist emphasis on the different economic classes, the workers and capitalists. Post-Keynesian thought has also been influenced by the work of the Italian-British economist, Piero Sraffa, who restored some Ricardian classical theory, where prices are determined by the costs of production.

Foundational Economics

The foundational school of economics encompasses all economic theory, micro, macro, and institutional. It seeks a comprehensive theory of economics, synthesizing the thought of all other schools in an integrated, systematic way, with a foundation based on a set of axiomatic propositions that apply to all people, times, and places. Pure theory is derived from these propositions using deductive logic. Specific theory about particular events, cultures, and economies is based on pure theory and the institutions and facts about the particular phenomenon, derived using hypotheses tested by data as well as deductively. The foundational school integrates moral and economic concepts, since it recognizes that pure markets follow moral rules.

The macroeconomic model is that of a pure market economy on which interventions are imposed. Pure markets work well, providing for prosperity and full employment. In accord with the physiocratic and neoclassical schools, foundational economics agrees that land rent is the efficient source of revenue for public goods and services. In accord with classical theory, it agrees with the principles of free trade. Its trade theory combines neoclassical and Austrian elements for an integrated theory with real and monetary aspects. It also accepts the Austrian theory of interest rates based on time preference and its theory of banking.

Foundational theory encompasses neoclassical marginal analysis and price theory, but retains the classical differentiation of the three factors of production. Socialist and interventionist views are not accepted, since these are believed to be flawed and/or lacking axiomatic foundations.

Foundational economics is open to theory from any school or approach so long as its pure theory that can be derived from axiomatic propositions. It can therefore potentially create a

synthesis from the other schools as a comprehensive and unified theory of economics.

The years of high theory (1930-)

Economics like all other sciences struggle with recognition, codification and explanation–understanding, prediction and finally control. The Great Depression exposed the weaknesses and missing links in neoclassical thought. To some economists, the Keynesian response is supplementary to neoclassical economics in the sense that it provided the neglected aspects in neoclassical thought that explained the Great Depression in the fallacy of the self-regulating hypothesis and in particular Say's law, which states that supply creates its own demand. To these economists, Keynesian economics is simply an extension of neoclassical economics – a couple of innovations in the mainstream economics. But, it is a lot more modern than this. It quickly and permanently changed the way the world looked at the economy and the role of government in society.

The word "economics" is derived from *oikonomikos*, which means skilled in household management. Although the word is very old and the discipline has evolved to the management of the city, district, local government area, the Caliph and the modern nation state as we understand it today is a relatively recent development. Modern economic thought emerged in the 17th and 18th centuries as the western world began its transformation from an agrarian to an industrial society. Despite the enormous differences between then and now, the economic problems with which society struggles remain essentially the same:

- What to produce with available limited resources?
- How best to produce the chosen commodities?
- For whom to produce?

- How to ensure stable prices and full employment of the available resources?
- How to attain balance of payments viability for the open economy?
- How to provide a rising standard of living both for the current and for future generations (sustainable growth and development)?

Progress in economic thought toward answers to these questions tends to have taken discrete steps rather than evolving smoothly over time. This may be because they are responding to the issues of the times. As changes in the economy yield fresh insights a new school of ideas suddenly emerges and make existing doctrines obsolete, at least inadequate. The new school eventually becomes the consensus view, to be pushed aside by the next wave of new ideas. This process continues today and its motivating force remains the same as those of three centuries ago: to understand the economy so that we may use it wisely to achieve society's goals in the best way possible.

Economic theories are constantly admitting new insights. When the Great Depression hit, with unprecedented ferocity, economists were at a loss to explain its causes and how to overcome it. Prevailing economic orthodoxy stuck to the old classical view that markets will clear in the long run. At the height of the crisis, the fledging Labour Government in the UK was told by Treasury officials that the government must balance the budget to survive the depression – a severe recession. This effectively meant increasing taxes and cutting unemployment benefits. Keynes described this as economic madness and argued for the exact opposite. He argued in a recession of this magnitude, it was necessary for the government to intervene and actively stimulate the economy.

In Keynes view output can be below full capacity for a long time because it was caused by gluts. For example, the Nigerian economy has been operating under full capacity since the 1980s – over twenty years long, though for very different reasons.

Apart from a few half hearted attempts such as the new deal, Keynes' policies were largely ignored in the UK and US; and high levels of unemployment persisted until the start of the Second World War. It was at the backdrop of this resistance Keynes published *The General Theory of Employment, Interest and Money* in (1936).

In a sense what is referred to a period of high theory is period of struggle for apostolic succession by various schools of thought that have emerged, which has struggled to interpret the content and importance of Keynes's message. Keynesian theory, with its emphasis on activist government policies to promote high employment, dominated economic policymaking in the early post-war period. Keynes is now known as the "father of modern economics" because he was the first to accurately describe some of the causes and cures for recessions and depressions.

Within the next few years, there were several important developments. The most crucial was the introduction of the IS-LM representation of Keynes's theory by John Hicks (1937), which is an attempt to combine the neoclassical microeconomics of Alfred Marshall and the macroeconomics of Keynes. This was to have a very deep impact in both economic theory and the conduct of economic policy. Hicks' representation provided a useful and efficient pedagogic device to popularize the Keynesian Revolution. However, by treating a subset of Keynes' theory as a system of simultaneous equations, Hicks' IS-LM was also the beginning of what has been called a "Neoclassical-Keynesian Synthesis", or "Neo-Keynesianism", the dominant form of Keynesianism which

took hold in America and, for the most part, the rest of the world.

However, starting in the late 1960s, troubling inflation and lagging productivity produced a phenomenon tagged stagflation (to refer to the co-existence of rising inflation and unemployment), which contradicted the orthodox trade-off theory and prodded economists to look for new solutions. From this search, new theories emerged:

- Monetarism updates the Quantity Theory, the basis for macroeconomic analysis before Keynes in its New Classical incarnation. It re-emphasises the critical role of monetary growth in determining inflation.
- Rational Expectations Theory provides a contemporary rationale for the pre-Keynesian tradition of limited government involvement in the economy. It argues that the market's ability to anticipate government policy actions limits their effectiveness.
- Supply-side Economics recalls the Classical School's concern with economic growth as a fundamental prerequisite for improving society's material well-being. It emphasizes the need for incentives to save and invest if the nation's economy is to grow.
- Post-Keynesian economists maintain that Keynes's theory is seriously misrepresented both by the Keynesian and by New Keynesian economics, which dominates today's mainstream macroeconomics alongside neoclassical economics. Post-Keynesian economics is an attempt to rebuild economic theory in the light of Keynes's original ideas and insights into how the economy works. Post Keynesian theory

evolves from Keynes's revolutionary approach to analysing a money-using, entrepreneur economy. Post Keynesian economics accepts Keynes' (1936, chap. 2) 'Principle of Effective Demand' as the basis for all macroeconomic theory that is applicable to an entrepreneurial economy. The Post-Keynesians are a heterogeneous group of economists, united solely by their rejection of the neoclassical synthesis, often claim the same name to their approach to macroeconomic modelling, namely Post Keynesian economics.

These theories and others were debated and tested. Some were accepted, some modified, and others rejected as economists search to answer the fundamental economic questions of what to produce with available limited resources? How to produce? For whom to produce? How to ensure stable prices and full employment of resources? How to provide a rising standard of living both for now and the future?

Marc Lavoie's Introduction to Post-Keynesian Economics has organised the various theories or approaches to economics into what is described by Figure 3.

Some writers have reduced all these into five main methodological subjects of economic science (see Glenn Rayp, 2009), namely, a review of the philosophy of science; the foundations of value theory; the partial and general equilibrium approach in economics; the relevance of a descriptive versus a formal-theoretical approach in economic

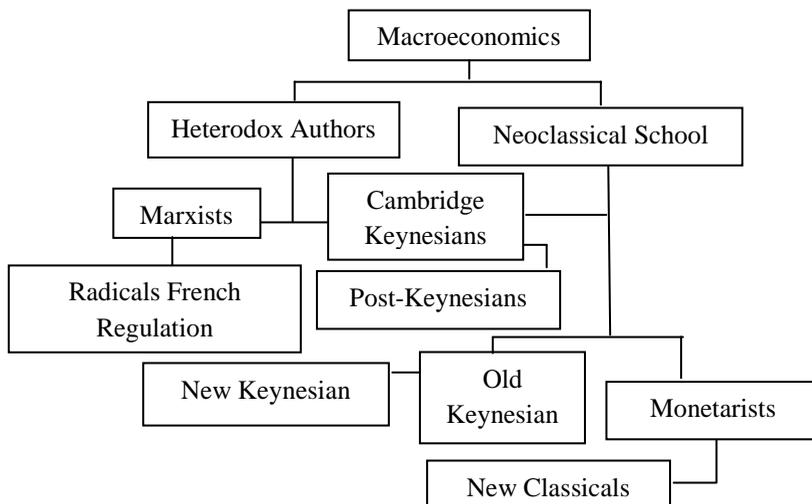


Figure 3: The Evolution of and Relations among Macroeconomic Theories

science; formalism and realism: the mathematical foundations and the computational approach of economics.

From Political Economy to Dismal Science

The Rev. Thomas Robert Malthus was the first professional to discuss economics. He was interested in the relationships among population dynamics, demographic transition and economic growth and development as well as their implications for the standard of living. In 1798, he published *An Essay on the Principle of Population*, describing his theory of quantitative development of human populations and their implications for food consumption per capita and the standard of living. His postulates were first, that food is necessary to the existence of man. Secondly, that the passion between the sexes is necessary and will remain nearly in its present state. Arguing further, he noted that these two laws, ever since we have had any knowledge of mankind, appear to have been fixed laws of our nature, and, as we have

not hitherto seen any alteration in them, we have no right to conclude that they will ever cease to be what they now are, without an immediate act of power in that Being who first arranged the system of the universe, and for the advantage of Its creatures, still executes, according to fixed laws, all its various operations.

He went on to say, if my postulates granted, I say, that the power of population is indefinitely greater than the power in the earth to produce subsistence for man. Population, when unchecked, increases in a geometrical ratio. A series that is increasing in geometric progression is defined by the fact that the ratio of any two successive members of the sequence is a constant. For example, a population with an average annual growth rate of, say, 2% will grow by a ratio of 1.02 per year. In other words, the ratio of each year's population to the previous year's population will be 1.02. In modern terminology, a population that is increasing in geometric progression is said to be experiencing exponential growth. Thomas Malthus postulated that population was growing at a geometric rate (2, 4, 8, 16...) while food production was only increasing arithmetically (1, 2, 3, 4) and concluded that food supply would eventually be insufficient to support the population.

This conclusion led him to oppose the introduction of the Poor Law and to advocate the protection of agriculture. In other respects he followed Adam Smith in opposing government intervention in commerce. Evidence in support of his postulates was lacking at the time and in some quarters it was believed to have since been found to be mistaken. His conclusions rightly motivated a sustainability debate that questioned whether the world will experience stable or improving living standards for the foreseeable future, or whether the existing trajectory will overtax the natural environment, leading to a 'crash' in living standards. In

contrast, Malthus believing in his postulates concluded that the growth of human populations will be naturally checked by misery, vice or the like in its natural development. Every phase of unchecked exponential population growth (as might occur when inhabiting new habitats or colonies, e.g. the American continent at Malthus' time, or when recovering from wars and epidemic plagues) will be followed by a catastrophe or misery, and thus unlimited growth in population may even directly cause misery and vice (Malthus 1798, chapter 7: *A Probable Cause of Epidemics*).

Malthus' grim prediction of starvation that would result as projected population growth exceeded the rate of increase in food supply, is variously referred to as the Malthusian catastrophe, sometimes known as a Malthusian check, Malthusian crisis, Malthusian dilemma, Malthusian disaster, Malthusian trap, or Malthusian limit. Again in 1839, Malthus repeated his theory in his essay *Chartism*. Indeed, the controversies on Malthus and the 'Population Principle', his 'Preventative Check' and so forth, are sufficiently mournful, dreary, stolid and dismal, without hope for this world or the next. **But, none of these is the science that made the prediction and therefore the science itself could not be dismal in any sense of the word.** Rather we had a science that gave humanity a wake-up call, alert and privileged information to avert a disastrous situation with non-zero probability. At any rate, **science and principles in themselves are holy, pure and innocent and that is even when they are wrong.** After all, it is said that “Logic is the art of going wrong with confidence” (anonymous).

Some people think that Malthus was wrong and believed that his theory has since been found to be mistaken; overtaken by man's ingenuity to conquer his environment with creativity that expressed itself in the Green Revolution and many other innovations. Further, Malthus did not show

evidence of foreseeing these developments. But, is Malthus wrong? In retrospect, his theory may be viewed inductive. Has famine ever left mankind alone? History counts at least 50 major Great Famines that resulted in significant losses of human lives during the time periods for which there are written records. In ancient Egypt 2686 to 1552 B.C. destructive floods of the Nile caused famine. Another reference is the seven years of famine reported in Genesis 41:1–44:17.

In China it is estimated that 'there was a drought or flood-induced famine in at least one province almost every year from 108 B.C. to A.D. 1911 (Mallory 1926). In the seventeenth century north China, for instance, famines became common, worsened by unusually cold and dry weather. In the same region in the 19th century, from 1876 to 1879 nine million fatalities were caused by famine. Famine continued in China until very recently. Between 1920 and 1921 in certain provinces 'at least 500,000 people died, and out of an estimated 48.8 million in five provinces, over 19.8 million were declared destitute. Between two and three million died in Honan province in 1943. The bungled reforms of Chairman Mao led to another massive famine in China. The 'Great Leap Forward' led to 'famine on a gigantic scale, a famine that claimed 20 million lives or more between 1959 and 1962. Many others died shortly thereafter, especially children, weakened by years of progressive malnutrition. China has only just escaped from famine. South Asia is another area where massive famines have occurred until very recently. Malthus saw it as one of the great famine areas of the world: 'India has in all ages been subject to the most dreadful famines.' The historical situation was summarized in 1911. 'Famines seem to recur in India at periodical intervals. Every five or ten years the annual scarcity widens its area and becomes a recognized famine; every fifty or a hundred years whole provinces are involved, loss of life becomes widespread, and a great famine is recorded. In the

140 years since Warren Hastings initiated British rule in India, there have been nineteen famines and five severe scarcities. Braudel refers to the 'terrible and almost general famine in India in 1630-1.' He quotes a Dutch merchant: 'People wandered hither and thither, helpless, having abandoned their towns or villages. Their condition could be recognised immediately: sunken eyes, wan faces, lips flecked with foam, lower jaw.

Another is The Great Famine of 1315–1317 (occasionally dated 1315-1322) was the first of a series of large scale crises that struck Europe early in the fourteenth century, causing millions of deaths over an extended number of years and marking a clear end to an earlier period of growth and prosperity during the eleventh to thirteenth centuries. Starting with bad weather in the Spring of 1315, universal crop failures lasted through 1316 until summer 1317; Europe did not fully recover until 1322. It was a period marked by extreme levels of crime, disease and mass death and infanticide. Due to meteorological conditions there were three great Japanese famines, namely, 1782 – 1787, 1833 - 1839 and 1866 – 1869. There was the Great Irish Potato Famine of 1845 to 1850, one of the most calamitous and significant events in modern Irish history, the repercussions of the Great Irish Potato Famine extended into all areas of Irish life and culture. An estimated around 800,000 people died of starvation or of a famine-related disease such as typhus, dysentery, scurvy or pellagra. A further two million people emigrated. There was the Australian Great famine of 1932-33 (see Lawriwsky, 2003). But, what about a more recent Sahel famine recorded after World War II and lasted till 1975 (see Mayer, 1975). Besides, there have been more recent food crises 2007 – 2008. For the 2008 episode of food crises, even here in Nigeria, surprisingly we rioted over the price of bread instead of over

the price of garri, amala or fur fur (cassava and yam staples for Nigerians).

The majority of crop failures that have resulted in famines are due to unfavorable environmental conditions with either drought or flooding being the most common causes. Less frequent, but also occasionally significant causes of famines are due to insect or disease infestations. Insect pests (the Emeozor, 2009 problem), like locusts, that can destroy crops were readily recognized by ancient civilizations and reliable historical information on insects as causal agents of famine is fairly common. Obtaining historical information on plant diseases, however, is not nearly as straightforward. The Bible and other historical texts refer to blights and blasts that periodically decimated crops, but information on specific diseases is lacking. This is understandable since the vital connection between plant diseases and the microscopic agents, like fungi and bacteria, that cause diseases remained unknown until the science of plant pathology was born in the mid-nineteenth century.

Whatever, the cause, once the demand for food exceeds food supply, there is food crisis and if the gap is severe, there is famine, irrespective of the explanation. But even with the birth of plant science, Green Revolution, the modern methods of agronomy and the many other innovations in food production, preservation, conservation and supply, there are many instances of food demand outstripping supply manifesting in episodes of food crises and rising food prices, even as recent as 2008, such that food aid is part of our lexicon. Thus, the actual indicator of food crisis is the rising trend in food aid and food prices, which are endemic. Figure 4 below is a queue for food aid.



Figure 4: Line for Food Aid; Picture Credit: Associated Press

Global Food Aid Deliveries - by Recipient Region (in tons)						
	Sub-Saharan Africa	Asia	Eastern Europe & CIS	Middle East & North Africa	Latin America & the Caribbean	Total
1996	2,570,098	2,012,284	1,311,682	567,484	766,793	7,228,341
1997	2,429,046	2,807,085	1,062,806	372,109	648,077	7,319,122
1998	2,776,666	3,390,315	866,878	369,518	992,418	8,395,795
1999	2,795,801	5,088,371	5,453,780	489,619	1,214,949	15,042,520
2000	4,001,553	3,172,577	2,272,134	1,070,314	828,173	11,344,752
2001	3,658,453	4,087,936	1,310,833	898,183	989,697	10,945,103
2002	2,881,346	3,678,558	948,339	694,818	1,203,324	9,406,384
2003	5,279,809	2,379,587	712,512	1,401,953	440,563	10,214,424
2004	3,648,180	2,034,445	453,844	617,926	554,410	7,308,805
2005	4,600,594	2,497,332	334,397	221,918	631,624	8,285,865
2006	3,962,392	1,425,655	423,607	508,439	641,623	6,961,716
2007*	3,187,018	1,742,916	311,951	344,983	348,945	5,935,813

Source: WFP INTERFAIS Food Aid Monitor
*provisional data

Figure 5: Global Food Aid Deliveries by Recipient Region
Source: World Food Programme's International Food Aid Information System (INTERFAIS)

Figure 5 shows the trend in food aid. In 2004 alone, governments, non-governmental organisations (NGOs), and the World Food Programme (WFP) delivered over 7.5 million tons of food, valued approximately US \$3.26 billion. The limit

of this trend is the Malthusian catastrophe as when food shortage leads to extreme malnutrition and death as the case shown in Figure 6.

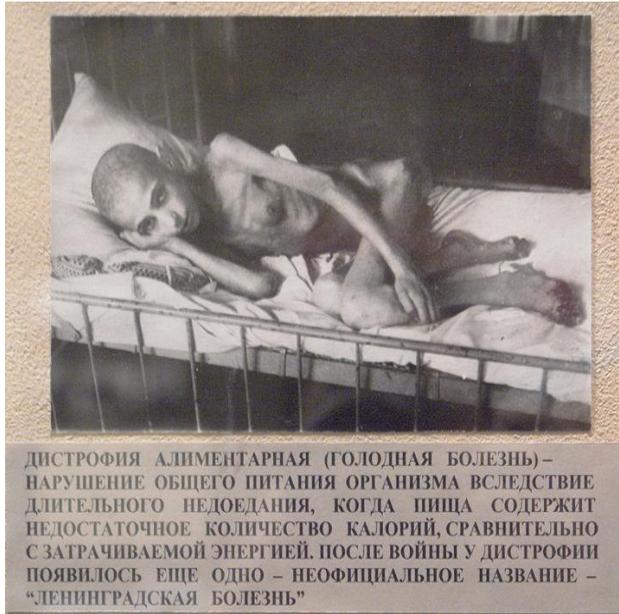


Figure 6: The Malthusian Catastrophe

So, is Malthusian limit mistaken as believed in some quarters despite the achievements of modern science? I don't think so. After all, it has been predicted that the food crisis, a problem that we faced in 2007 and 2008, will be back sooner than expected (see China Daily (The National English Language Newspaper, Tuesday July 7, 2009)). Several reasons are advanced for this including the Malthusian arguments such as the growth of world population; a lesser cause is competition from biofuels for land use. But, with oil prices rising as it did before the crash, there are strong economic incentives for biofuel projects and possibilities to compete

with food production and use. Food and Agricultural Organisation (FAO) estimates that the world will need to produce at least 50 percent more food in the next 15 years. Economic development and income distribution in highly populated countries such as India, Brazil, China and Indonesia are creating millions of new food consumers despite birth control measures. Migration and urbanization is leading to the growth of more mega cities, which is increasing food consumption and reducing land for agricultural production.

It is not surprising therefore that despite the fact that, the dismal science terminology is a derogatory alternative name for what was named Political Economy and is today referred to as economics devised by the Victorian historian Thomas Carlyle in the 19th century; the modern world has found it very wise to adopt the **Malthusian checks** in the romantic name of **family planning** to refer to the use of modern contraception and other methods of birth control to regulate the number, timing, and spacing of human births.²¹ Figure 7 shows a woman being chased by an unwanted baby.



Figure 7: A Woman being chased by an Unwanted Baby

²¹ In my view the definition should be expanded to include all methods that improve maternal health,

Her lot improved only in 1965, when the US Federal Government made its first grants to support the provision of family planning services in 1965 as part of the Johnson administration's War on Poverty. The major breakthrough came in 1970 in what was stylized Title X, which sought to fulfill President Richard M. Nixon's historical 1969 promise that "no American woman should be denied access to family planning assistance because of her economic condition." Data show that since 1980, Title X has helped American women avoid almost 20 million unwanted pregnancies, and has provided key reproductive health services to millions of women. Today, family planning clinics are a common feature the world over.

Admittedly, Attempts to control human reproduction is not entirely a modern phenomenon. Throughout history, human beings have engaged in both pro-and anti-natal practices directed at enhancing social welfare. In many foraging and agricultural societies a variety of methods such as prolonged breast-feeding were used to space births and maintain an equilibrium between resources and population size. But in hierarchical societies, population regulation practices did not bring equivalent or beneficial results to everyone. Anthropologists Marvin Harris and Eric Ross have shown that "As power differentials increase, the upper and lower strata may, in fact, develop different or even antagonistic systems of population regulation". This, notwithstanding, Malthus has helped to put population regulation in the consciousness of humanity.

Why and How the Dismal Science Got Its Name

It is often stated that Carlyle gave economics the nickname "dismal science" as a response to the late 18th century writings of Malthus. The Carlyle did indeed use the word 'dismal' in relation to Malthus' theory in his essay

Chartism (1839), while Carlyle did indeed use the word dismal here, it is was not until a decade later that he brought the adjective into juxtaposition with the noun "science" to give the sense of the expression we understand it today – **a situation which both threatens the extinction of life on Earth, and offers no promise.** But, this is not the real reason why Carlyle labeled the then Political Economy “dismal science”.

The emphasis that classical economists place on incentives also leads them to reject racial explanations for social progress. Thomas Carlyle was a well-known English social critic and essayist, who used this term in an angry response to the classical economists (the most prominent being John Stuart Mill) for criticizing his position that slavery should be continued because blacks were inferior to whites and incapable of taking care of themselves (the remark occurs in his "Occasional Discourses on the Negro Question," published in 1849). Carlyle's argument was, in part, based on the lack of social and economic progress blacks had achieved in their own societies. The blatant racism represented in the writings of Carlyle, and commonly accepted in his day, had long been criticized by economists going back to Adam Smith. The classical thought and discourse by positing the equality of the races and propagating the idea that free market economies would provide social solutions, argued that slavery was an unproductive mode of production.

Thus, the dismal science label shows how racial theorising was used to attack anti-slavery coalition of evangelists and economists in the mid-nineteenth century Britain. Classical economists favoured race-neutral accounts of human nature, presuming that agents are equally competent to make economic decisions, (see Peart, S. J. and David M. Levy, 2001). Their opponents Carlyle and Ruskin presupposed racial hierarchy and argued that some people are incapable of making

sensible economic or political decisions. They further argued that those who are systematically poor optimizers will be victimized in either market or political transactions. Thus, it is the position of the classical economists that motivated the assumption of homogeneous agents in mainstream neoclassical economics for which it is being criticized. Admittedly, agents are heterogeneous in their capacities for optimisation but the differences are not necessarily to inherent racial incapacities as differences are found within the races or racial groups.

The Rise to a Mathematical Science^{22, 23}

In a sense the historiography of mathematical economics may be said to have been written only in 2002 with the publication of Weintraub's *How Economics Became a Mathematical Science*, in which he traces from Marshall forward how high-level mathematics came into and changed the presentation of modern economics adopting biographical and scientific approaches to the history of economics.²⁴ But, many place the beginning of the mathematisation of economic analysis in 1838 when Antoine Augustin Cournot published his *Mathematical Methods in Economic Investigations* in which he presented the concept of economic equilibrium and the analysis of monopoly and duopoly as well as the concept of consumer surplus. Actually, economics became a mathematical science in Quesnay's *Tableau Économique* in 1774 before it became Political Economy in 1776 with the

²² I would have preferred to name this unit 'the rise to a computation science', for what makes economics scientific is not just mathematisation but the entire quantitative methods and advances in computational technology and devices that have been brought to bear on economic analysis through time. It was William Stanley Jevons who first observed that it was statistics that was limiting Political Economy from becoming a science.

²³ I have relied heavily on the literature, in particular those found on the internet, some of which I am not able to cite and/or reference properly.

²⁴ This author has no direct access to the book, so references are based on excerpts, reviews and comments on the book. The book itself is a compilation of papers written by the author either singly or with collaborators.

self-consciousness among American economists, who also demarcated the establishment of an altogether novel protocol for those experts (examples are the establishment of Mathematical Economics at Cowles Foundation and the publication of both *Econometrica* and *The Review of Economic Studies* that began in 1933). This new agenda, developed with increasing rigour and authority as the twentieth century beckoned, began a significant reorientation of the field's object of study. Scientific sophistication necessarily involved a revision of practice, yet it also encouraged the articulation of new perceptions of its pedigree in linking the object of study with particular and venerable authorities through the ages as a process of importance to the successful construction of a distinctly professional knowledge.

The interconnection of mathematics and economics reflects changes in both the mathematics and economics communities over time. The respective histories of these disciplines are intertwined, so that both changes in mathematical knowledge and changing ideas about the nature of mathematical knowledge have effected changes in the methods and concerns of economists.²⁶ Mathematics went through crises and paradigm shifts, which spilled over into economics which is the key to understanding how mathematical economics has evolved. The rise of the ultra-formal Bourbakist School in France, which used ultra-formal, abstract and axiomatic methodology in mathematics and the education that Gérard Debreu by some of its founders facilitated along with the new American agenda for economic research referred to earlier facilitated the spillover. Thus, the mathematisation of economics may be viewed as the response of economic theory to the achievements in science.

²⁶ See the new edition of *The New Palgrave*, a Dictionary of Economics, published by Macmillan on Mathematics and Economics.

Understanding the nature and role of mathematical economics is not the same as understanding the connection between mathematics and economics. Mathematical economics, as Debreu argues is the employment of mathematics in economics itself. Explaining or justifying mathematical economics often involves essentialist arguments concerning the true nature of economic objects, and the true nature of the economy, as well as arguments suggesting that employing mathematics is appropriate since the underlying “economy” is quantitative in nature. Consequently an historical discussion of mathematical economics will be a narrative of increased sophistication over time in economics as mathematical tools, techniques, and methods are refined and move into economic discourse and enrich economic analysis.

In a sense, mathematics is incarnate in economics. For example, a roadside trader selling roasted corn in determining her sales revenue is working with the equation $PQ = R$ (P = price per unit, Q = quantity sold and R = sales revenue) and if she sells the roasted corn with other items such as roasted fish, pear, and/or water, then, she is working with the equation

$$\sum_i^n P_i Q_i = R$$
, (where $i = 1, 2, \dots, n$; P_i = price per unit of item i , Q_i = quantity sold of item i and R = total sales revenue); that is whether she is conscious of it or not. Figure 9 shows this tendency with the help of commonly available technology just like traders in the New York Stock Exchange.



Figure 9: Mathematics in Business &



Figure 9A: Traders on the floor of the New York Stock Exchange.
Source: AP Photo

According to Wikipedia the use of mathematics in the service of social and economic analysis dates back to the 17th century. Then, mainly in German universities, a style of instruction emerged which dealt specifically with detailed presentation of data as it related to public administration. The development of mathematical economics started from a humble beginning with numerical examples to the application of algebra and calculus with the Marginalist Revolution in the 19th century, which accelerated in the early 1930s to the present. Of these, one of the most impressive has been the steadily increasing sophistication of the mathematical tools used by economic theorists. To calculus and matrix algebra were gradually added, a non-exhaustive list, game theory, linear programming, operations research, set theory, convex analysis, general topology, algebraic topology, measure theory, infinite-dimensional vector space theory, global analysis, optimal control theory, nonstandard analysis, fixed point theorems, application of mathematical proof making – axiomatic proofs and probability theory, etc. Simultaneously, as economic theory was axiomatised, exacting standards of logical rigour became the rule rather than the exception. The

sweep of the recent evolution of mathematical economics may tempt one to find in that historical process an inevitable concatenation of events and to overlook the major accidents that altered its direction and/or increased its momentum. But historical determinism does not fully explain John von Neumann's interest in game theory and in economics as well as the circumstances that led to his collaboration with Oskar Morgenstern. Nor does it explain the role played by institutions and other individuals.

By mathematical economics, economic theory is transformed into a compact and precise mathematical form by using appropriate mathematical functional form. For example, the law of demand tells us that when other things do not change the price and quantity demanded are inversely related. As a first approximation to this demand law, economists often use linear equations of the type $q = \alpha + \beta p$; $\alpha > 0$, $\beta < 0$ to make the analysis simple. To depict the needed convexity shape of the indifference curve, economists use rectangular hyperbolic functional form. To state the behaviour of the total cost, economists often use cubic functions. Once such transformations are made, it is often possible to derive interesting further properties from the said mathematical functional form. But, this has nothing to say about the appropriateness or adequacy of the framework being adopted.

Further, it is important to note that mathematical economics is not a separate branch of knowledge by itself. It is simply an approach used in economic analysis very frequently. Thus, mathematical economics is an approach used in almost all the branches of economics. Yet, one must remember that mathematical economics is not merely an alternative way of representing economic theory. The very purpose of such a transformation is not only to make the theory easy to handle but also to derive certain interesting characteristic results. For example, after transforming both demand and supply functions

into simple linear mathematical form, it is possible to easily calculate both the equilibrium price and the quantity. Similarly, it is possible to calculate the appropriate tax rate that gives maximum tax collection to the government, etc. It is important to note that such typical questions can be answered more precisely only by using mathematics. Therefore mathematical economics can always be considered as complementary rather than competitive in economic analysis.

Advantages of Using Mathematics in Economics

1. The mathematical language by nature is concise and precise. Hence by using mathematics, it is possible to restate economic theory in a more compact form like the one stated above to represent the law of demand. In it, the relationship involved is simple and self-explanatory in its mathematical form.
2. It allows formulation and derivation of key relationships in a theory with clarity, generality, rigour, and simplicity.
3. The mathematical simplicity enhances the precision of analysis like the calculation of equilibrium price, equilibrium quantity, price elasticity of demand, etc.
4. Mathematics allows economists to form meaningful, testable propositions about wide-ranging and complex subjects which could not be adequately expressed informally. Further, the language of mathematics allows economists to make clear, specific, positive claims about controversial or contentious subjects that would be impossible without mathematics.

5. Mathematical economists can always have the added advantage of using the ever growing unlimited amount of tools and theorems in pure mathematics. The use of Euler's mathematical theorem in economics in explaining the distribution of income among the factors of production is a classical example for such an advantage.
6. Once a certain specific mathematical relationship is obtained, the mathematical economists can deduce interesting and more useful new propositions and theories by applying suitable mathematical methods.
7. The application of mathematics to economics helped the development of rigour in measurement and description.
8. The biggest advantage of mathematical economics is its ability to handle large number of variables at a given point of time. For example, in the theory of consumption especially in indifference curve analysis, at the most one can handle only two commodities, one along the x-axis and one along y-axis. But in reality our consumption basket contains a large number of commodities. Mathematical economists can handle this situation by increasing the commodity space to accommodate any number of commodities in getting the extended equi-marginal equalities (principle).

Disadvantages of Using Mathematics in Economics, Misuse and Abuses

1. In certain sections of economics, variables such as tastes, preferences, etc. are qualitative in nature and as such are not measurable, yet quantifiable, which make the use of mathematical techniques difficult.
2. The most common criticism levelled against mathematical economics is about its abstract nature, in particular axiomatic mathematics. However, generally speaking, the abstract results are due to the use of unrealistic assumptions and not due to the use of mathematics per se. Therefore, whenever the assumptions of the theory are more realistic, less will be the abstract nature of the theory both in mathematical and in nonmathematical presentations.

Despite, these weaknesses, in its mathematical form, economic theory is open to an efficient scrutiny for logical errors.

Use of Statistical Methods in Economics

Statistics is another important branch of knowledge having wider applicability in economics. Since very often economic theories are constructed on the basis of real world observations, statistical analysis plays a crucial role in the development of economic theories. To quote Marshall “Statistics is the straw out of which I, like every other economists, have to make my bricks”. It was Jevons who first observed that it was statistics that was limiting the scientific nature of Political Economy. In fact the quantity theories of money have undergone drastic revisions after being tested for

their reliability or otherwise now and then by using the real world data. Thus statistics plays a unique role in testing economic theories empirically and in promoting the scientific nature of economics.

Importance of Econometrics

In recent times another quantitative approach, called econometrics, has emerged as an important tool in economic theorizing. The empirical content and policy significance of economic theories are the two important faces of this new approach. The socialist economist, Oskar Lange defines econometrics as “The science, which deals with the determination of quantitative laws occurring in economic life.”

Mathematical economics plays an important role in translating the verbal economic theories into its mathematical form. Econometrics in combining economic theory, mathematics and statistical techniques provides the necessary tools in testing the so-obtained mathematical statements of the concerned theory. Thus it is a branch of knowledge that deals with the empirical measurement of economic relationships listed out in economic theories for purposes of hypotheses testing. For example, the linear demand equation given above is only a restatement of the date old demand law in its simplest mathematical form.

Econometrics proceeds further in this direction by measuring the tightness of this inverse relationship using the statistical tools like correlation or better still regression analysis among other methods. It is also used to test the reliability of the inverse demand law by using statistical tools. Once the reliability of the relationship is established the so-obtained relationship is used to forecast the likely changes in quantity demanded for an expected change in price on a future date. This is the practical utility of econometrics. **Its results can be used for prediction and control purposes.**

One must remember that before testing a theory for its reliability, it must first be translated into a suitable mathematical form. It is also true that the statistical tools are commonly used in econometrics. So, econometrics is indeed a trilogy among economic theory, mathematical formulations and statistical techniques. Thus the basic relationships, which are analyzed in econometrics, are economic relationships expressed in mathematical form, which are measured using statistical techniques. Hence, for a good understanding of the subject “econometrics” one must be good enough in economic theory, in addition to competence in the use of mathematical and statistical tools. In facilitating the measurement of economic relationships, it helps in causality testing.

However, the development of econometrics as a field of knowledge has been greatly facilitated by advances in computing power and availability of algorithms to analyse data, which have made possible more sophisticated use of data. Thus, it is the entire gamut of quantitative economics and computing technology that has made economics the science that it is.

What type of Science?

Is Economics a Science?

First, is the question of whether economics is a science? This is one question that people have been asking themselves throughout time and many doubt if economics can be considered a science, (Martie, 2009). Even the Nobel Prize in Economic sciences instituted by the Sveriges Riksbank (the Central Bank of Sweden) in Memory of Alfred Nobel, which has been awarded 41 times to 64 Laureates between 1969 and 2009 to some is not so Nobel, a good example is Brittan

(2003).²⁷ Some say that economics combines elements of both science and art given that economists try to develop analytical mathematical models which seek to explain economic behaviour in a way that can be theoretically proved (see www.blurtit.com/q761673.html accessed 20/9/09). But, linking theory to the real world is always going to be a very subjective experience. Economists face very serious difficulties in testing their theories because of the complexity of the subject matter and because of the presence of a lot of disturbances. So, as Hausman (1994) asserts, they are right in trusting more in the implications deduced from the axioms of their theories than in the negative results which may emerge from empirical testing. For this reason, it is very rare to see a theory disregarded because of an apparent refutation, (Beker, 2005). In economics uncertainty is the rule. Fortunately, at least, some economists are well aware of the limitations of their analyses.

For the anarchists who question the realism of economic assumptions, in the main, economics is not a science. But, they are not alone. Among the critics are even economists, even notable economists are among their numbers. For example, Mark Blaug is quoted as saying "no time [should] be wasted defending the assertion that economics is a science", (John, 2009). Some say it is debatable whether economics should actually be defined as being a science like Mathematics or Physics.²⁸ Since these disciplines usually gets their satisfaction from proving something to be irrevocably

²⁷ In my view, these awards represent the recognition seminal work by the awardees and the schools of thought they help to lead as well as motivation for distinction and excellence in analytical economics and of course with implications for policy applications of their. Unfortunately, the criticisms of the Award are confusing issues for The Royal Swedish Academy of Sciences – the Awarding body. If some entity institutes an award for a specific purpose and is accepted, is for them to follow through with the conditions of the engagement and not to waiver and award it to any and persons in the social sciences.

²⁸ Ironically, in many universities mathematics is regarded as an art.

true.²⁹ Solve a complex equation and quod erat demonstratum (QED), that's the answer, there's no argument. Economics on the other hand, critics say, will rarely give a simple answer. Ask 5 economists a question and the joke goes you will get 6 different answers.^{30,31} What is wrong with this perspective is that first the comparison is odious. Economics is different from physics, mathematics, chemistry and biology. Accordingly, there are cultural differences between natural scientists and economists and these should be obvious and acceptable. Therefore, assessments of economics should speak to its nature. Given economics' peculiarities it does not seem reasonable to judge its scientific character on the basis of its ability to use the methods and procedures of the experimental sciences in exact manner. It seems more reasonable to analyze how to satisfy the requirements of the scientific methodology taking into consideration its particularities as a social science. There can be analogies leading to generic use of concepts and methods, but that is a different matter. Second, it forgets that in computational mathematics, many solutions are approximations, which in essence means we don't know the answers. So, how exact is mathematical science is a pertinent question. There are people who do not even consider mathematics as a science.

In line with the above criticism, some say economics is not a science as it cannot produce “universal (natural) laws or constants”. For example, Luskin (2006) questions: “Where is the utterly essential ingredient of repeatable experimental verification of falsifiable hypotheses? Without that – and

²⁹ But, this only means that physical science theories are yet to be contradicted by available evidence. With objects as heavy as humans floating in outer space, wouldn't the Law of Gravity be properly rephrased as ‘everything that goes up will come down within the stratosphere?’

³⁰ There is a plausible explanation for this. Economists think in terms of alternatives and given the inability of any human being to see and think at 360^o-degrees vision, variations exist.

³¹ I am surprised it is not ten answers since economists always have two hands.

economics surely doesn't have it – there can be no claim to science or the scientific method.” First, Luskin seems unaware of the existence of experimental economics that has become a discipline. After all, Vernon Smith won the 2002 Nobel Prize in economics jointly with Daniel Kahneman for his work in experimental economics. Second, in my view, what is essential is the availability of relevant data for verification and not the particular method of data production or acquisition, per se. In the least, economics uses observational data produced by natural experiment (see Bloom, 2008). Further there are many non-experimental sciences that use the data that history provides such as astronomy, which studies the creation of galaxies that cannot design experiments but only observe limited conditions. Another example is evolutionary biology that studies the development of species; also behavioural biology relies upon fieldwork in uncontrolled environments. At any rate, not even all aspects of physics are open to repeatable experimental verification or falsifiable hypothesis. After all, each of the current "hard sciences" suffered a similar "lack of rigour" in its own infancy.

John (2009) has argued that the empirical background of economic science is definitely inadequate. Our knowledge of the relevant facts of economics is incomparable to those in other sciences. This begs the question: what quantity of data or empirical background is adequate for science? However he believes that if economists can start with problems contained in the very simplest facts of economic life and try to establish theories which explain them and which really conform to rigorous scientific standards, then, we can have enough confidence that from then on the science of economics will grow further, gradually comprising matters of more vital importance than those with which one has to begin. My question is what does the history of thought and methodology in economics reveal? He argues further, although mathematics

has actually been used in economic theory, perhaps even in an exaggerated manner, its use has not been highly successful. This is contrary to what one observes in other sciences. Thus, he disagrees with von Neumann and Morgenstern's *Theory of Games and Economic Behaviour* and their conclusion that economics is a science. To decide if economics, as a science, is solid enough to explain and predict the effects of different actions, we must first know what exactly science is (Martie, 2009, <http://econosofia.wordpress.com/2009/03/22/is-economics-a-science/>).

What is Science?

Philosopher Karl Popper's widely accepted definition of science says that a statement is scientific only if it is open to the logical possibility of being found false. This definition means that we evaluate scientific statements by testing them, by comparing them to the world about us. The corollary of this is that a statement is nonscientific if it takes no risk of being found false; that is, if there can be no way to test the statement against observable facts or events. Popper called this distinction the "line of demarcation" (see Schenk, 2009). An implication of Popper's definition is that one can never be completely sure that any scientific theory is true. Accepted scientific theory is only theory that has not yet been contradicted by evidence, though the future may bring a contradiction. That is, the fact that all previous experience has been consistent with the statement does not prove that the statement will never be refuted. After all, we are told science consists of the endless process of trying to falsify hypotheses.

Popper saw the growth of scientific knowledge as a process of conjecture and refutation (see <http://www.ingrimayne.com/econ/Introduction/Science.html> 15/07/2009 accessed 20/08/09). If this is anything to go by then science progresses not by the old adage of funeral by

funeral or Mankiw (2006) proposition of retirement by retirement but by succession by succession. Thus, as Clower (1994) asserts progress in economics features Kuhnian anomalies. However, succession is not by a ‘free pass’ but by struggle and competition such that competitive theories exist side by side. At a more fundamental level, knowledge is relative (to time and space) approached in slices, which makes it incremental and cumulative given that we do not see at 360°–degrees vision. For these reasons theories are both right and wrong at the same time. But, they all provide some insights and some are useful.

Mannan (1983) asserts that “the touchstone of science, we all know is its methodology not its conclusions”. The scientific method is what makes science respectable. But the scientific method has also a serious draw back in that it is not capable of studying everything. What then is the scientific method?

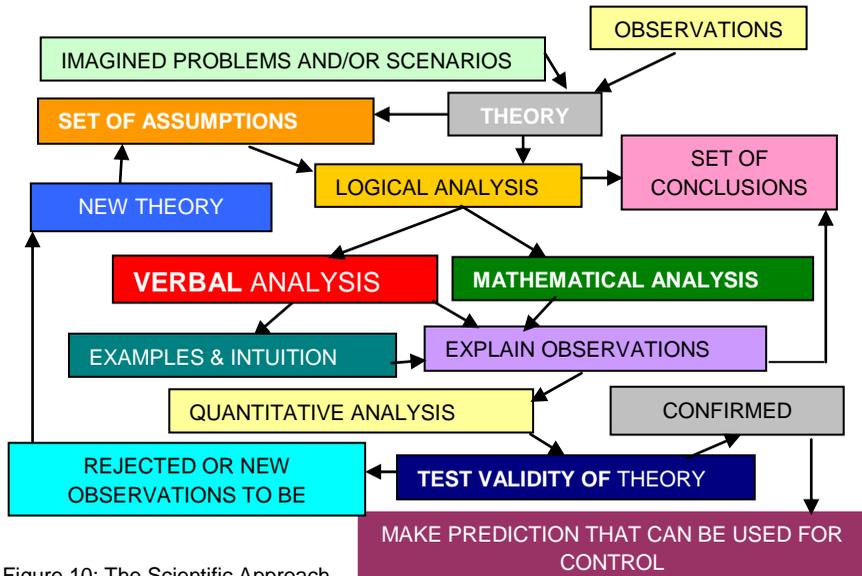


Figure 10: The Scientific Approach

Figure 10 presents a summary of the scientific process. Science is both a process of gaining knowledge, and an organized body of knowledge gained by the process. The scientific process is the systematic acquisition of new knowledge about a system. This systematic acquisition of knowledge is generally the scientific method, and the system is general in nature. Science is also the scientific knowledge that has been systematically acquired by the scientific process (Science Journal). These features of science are essentially captured by Figure 10. But science is different things to different people. For example, what natural scientists call theory are facts, whereas theory in economics refers to ideas. Main stream economics start with ideas and end with data analysis for purposes of verification. Yet, there are common trends or features even if in generic form. Consequently, the term "science" is sometimes pressed into service for new and interdisciplinary fields that make use of scientific methods, at least in part, and which in any case aspire to be systematic and provide careful explorations of their subjects, including computer science, library and information science, and environmental science. Mathematics and computer science reside under "Q" in the Library of Congress classification, along with all else we now call science (ibid.).

Generally speaking, in my view, economic analysis is reasonably compliant with the scientific method; though not all aspects or branches of economic analysis is equally compliant. There are many branches in economics at differing stages of methodological development. However, some writers tend to think that the two methods of generalizations in scientific enquiries – deduction and induction – are mutually exclusive. This is not obvious in Figure 10. The explanation of the past and the prediction of the future are not different operations, but the same worked in opposite directions, the one from cause to effect, the other from effect to cause. As Schmoller (1838 –

1917) says, "to obtain knowledge of individual causes we need induction; the final conclusion of which is indeed nothing but the inversion of the syllogism which is employed in deduction. Induction and deduction rest on the same tendencies, the same beliefs, and the same needs of our reason." The economists approach to scientific economics recognizes that deductive and inductive methods are inseparable aspects of one goal, the production of scientific knowledge.

According to an academic definition, science is the organised body of knowledge that is derived from observations of natural events and conditions that can be verified or tested by further investigations (Martie, 2009, *ibid.*). Both Figure 10 and practice show that economics is compliant, at least reasonably so. Economics became an organised body of knowledge when it became separate branch of knowledge as Political Economy in 1776 referred to by its proponents and practitioners as science because it met the essence of the above definition. At any rate, the word science comes from the Latin word, *scientia*, which means knowledge. Until the Enlightenment, the word "science" (or its Latin cognate) meant any systematic or exact, recorded knowledge. "Science" therefore had the same sort of very broad meaning that "philosophy" had at that time (*ibid.*). Sometimes, the distinction is made between, for example, "hard sciences" and "soft sciences," which speaks to relativity.

Nelson (2005) asked if economics is a natural science in which she questions the distinction of advocates for a more socially responsible discipline of economics that emphasize the purposive and unpredictable nature of human economic behaviour, contrasting this to the presumably deterministic behaviour of natural forces. She argues that the distinction between "social" and "natural" sciences is in fact counterproductive, especially when issues of ecological sustainability are concerned. She believes that in drawing such

a line, they draw on intellectual habits of using dualisms such as culture vs. nature, mind vs. body, human vs. animal, and freedom vs. determinism which have a long history in post-Enlightenment Western thought. She argues that this kind of dualistic approach creates gaps that are inevitably difficult to jump over or consistently bridge. What is needed instead, she maintains, is a better notion of science – “science-with-wonder” – which grounds serious science in relational, non-Newtonian thinking. So, she does not agree with the metaphor that economies can be modelled as mechanical and deterministic machines working according to given laws and the neoclassical economics extremal approach to economic analysis, which she regards as profoundly reductionist. But, outside reduction wouldn't we be assuming omniscience (all knowing)? The pertinent question is this a plausible assumption? In my view, what needs to be addressed is how much reduction is acceptable, which no one seems to address. I believe the answer is variable to cases.

Over the course of human history, people have developed many interconnected and validated ideas about the physical, biological, psychological, social and economic worlds. Those ideas have enabled successive generations to achieve an increasingly comprehensive and reliable understanding of the human species, their behaviours in different environments. The means used to develop these ideas are particular ways of observation, reasoning, experimentation, and validation. These ways represent fundamental aspects of the nature of science and reflect how science tends to differ from other modes of knowing. Economics is an observational theoretical and applied social science, which is increasingly becoming experimental, at least in its core aspects, namely, market phenomena (see Roth and Kagel, 1999) supplemented by market design studies. More importantly, experimental economists have uncovered the basic principles of economics.

The laws of demand and supply might be the best examples. These principles, which predict the price and volume of ultimate market equilibration, work with amazing accuracy under appropriate conditions. This is particularly true once the distinction is made between short run dynamics that obstruct market clearance and the long term tendency of market clearing.

Further, it is the union of science, mathematics, and technology that informs the scientific endeavour and makes it so successful. Although each of these human enterprises has a character and history of its own, each is dependent on and reinforces the others. Accordingly, the discourse should draw from portraits of science, mathematics, and technology that emphasise their roles in the scientific endeavor and reveal some of the similarities and connections among them.

The terms "hypothesis", "model", "theory" and, "law" have a different use in science to colloquial speech. As Foldvary puts it, model is a small-scale replica of the 'larger real-world'. Scientists use the term model to mean a description of something (structural relationship(s) in economics), specifically one which can be tested by experimental or observational data that can be used to make predictions. A scientific model is a set of concepts, assumptions and propositions, which, like maps, demonstrate the main features of the phenomenon being analysed. A hypothesis is a contention that has not (yet) been well supported nor ruled out by falsification. A physical law or a law of nature is a scientific generalisation based on empirical observations.

Mathematics is an essential language of science but it does not make a science. The most important function of mathematics in science is the role it plays in the expression of scientific models. Observing and collecting data for measurements, as well as hypotheses testing and predicting,

typically require mathematical models and extensive use of mathematics and statistics. Mathematical branches most often used in science include algebra, calculus and statistical tools and techniques, although virtually every branch of mathematics has applications, even "pure" areas such as number theory and topology. After all, Kapur (1965:3) asserts that every science evolves in three stages, namely,

- the descriptive stage involving the verbal description of observed facts with the use of quantitative techniques being almost nil.
- The predictive stage - the stage at which the science is capable of making verifiable statements in the forms of hypotheses about events which may have occurred but not yet observed or has not occurred at all. At this stage the scientific method informed by mathematical logic has become essential, for a theory is necessary for prediction which comes from understanding. This in turn comes from explanation - the main function of theory. Besides, from theory come conclusions as theorems are deduced from mathematical axioms. And
- the control stage at which the science has developed through time to acquire the capability for controlling the behaviour of the variables characterizing the relationships which it studies. Economics, particularly, microeconomics and macroeconomic engineering (see Mankiw, 2006) have reached this stage of development.

In my view, what we have is an economic science that uses mathematics as a reasoning tool and one of its languages

of communication. This perspective sees mathematics as performing instrumental function in economic analysis.

Martie argues that even if we take into consideration that science is just “the belief in ignorance of experts” one thing is certain: because in large part economics reflects human beliefs we might think that it is not a science in the way that physics, chemistry or mathematics is. We all agree with the fact that economics rely on past experiences and that it is based on mathematical theories applied to conditional scenarios. But, if economics is a science why can’t economists predict tomorrow’s economy and sometimes they can’t even agree on the present situation? He went on to answer his question. “I believe that the answer is simple: people are the reason for a changing economy. We often behave in ways that are unpredictable as a consequence of our emotional reaction to different situations and the decisions we make are not always compatible with an economic behaviour. Furthermore, economics is a complex system with multiple interacting causes and, as a consequence, sometimes, economists have to reduce the number of variables to simplify the situation in order to create a model. But ending up this way might lead to a model relied on unrealistic assumptions and the discrepancy between it and reality would be unavoidable. Moreover, there are a lot of situations when causes and effects are no longer related. As a result, this attempt to concretize the abstract human behaviour may fail and give us the false sensation that economics lies. To conclude, I believe that economics, although is rather more observational than experimental and inevitably limited, is clearly a science which has a great impact on the course of our lives”, (Martie, 2009, *ibid.*).

However, to say that economists cannot say anything about the future is not true. The conclusions of economic theories are largely predictive in nature – they deal with consequences; so, are the results of forecasting and simulation

exercises quite different from predictive accuracy where errors arising from many sources could become serious issues. Further, a theory is not supposed to replica reality, otherwise it becomes a tautology. It is a metaphor, which like a map is different from the reality it represents and this is the root of falsifiable hypotheses in economics. Yet, it is intuitively admissible that the closer the assumptions of a theory are to reality, the most likely will be its predictive accuracy.

Given the recent gruesome experience – the subprime bubble induced financial meltdown and its sequel, the global recession, some ask, if economics is a science, why didn't many economists see it coming? Prudential guidance and risk management principles and practice show that these kinds of crises can be avoided. Bankers neglected them, crisis ensues and economists are to be called short-sighted. Besides, the question is: don't we see the hurricanes and tornados coming, do we stop them? According to Ibn Khaldun (732-808 AH/1332-1404 C.E.) of Tunisia growth and decline are the various stages through which every society must pass. So, the business cycle and macroeconomic volatility are by his insight to some extent natural. But, economists have found ways to moderate and dampen them and to accelerate recovery. The reference is to the Keynesian interventionist policies.

The question critics of economics fail to ask is: what would have been the outcome or situation in the absence of economic theories and policy prescriptions? The answer is counter factual yet pertinent. Equally important, is that economists are technocrats who add to the database to inform policy. They do not enforce their policy recommendations. What policy- and decision-makers (mostly politicians, who politic) as well as implementers (who may be self-serving or rent-seeking) and their misinterpretations, do with the prescriptions, which may be different from the prescriptions, determine actual outcome(s). It is like a doctor's prescription

to his/her patient, who either takes an overdose or under-dose or not all such that the drug is not effective or complications are created and the doctor is blame for all that. A good example is the Nigerian Structural Adjustment Programme (SAP) in the late 1980s – we gave it a human face (under-dose) and the problems are still with us. You bailout AIG and it fritters the bailout money on bonus payments to those who caused the company's failure in the first place and things don't workout. Who is blame? Economists? For the failures of policy and predictions in the face of uncertainties and uncontrollable disturbances, critics deny economics is a science.

Cowen (2004) thinks differently and asserts that economics is surely a science. He argues "economists have produced empirical knowledge which is subject to the process of testing, broadly interpreted, and feedback. We even now have controlled experiments. While competing fields such as String theory is yet to be empirical. Environmental science and ecology are rife with ideology. Astronomy doesn't have controlled experiments. And isn't chemistry just plain outright boring? There is plenty of empirical economics I don't trust, but usually it is for quite hackneyed reasons (example, data mining), rather than for "intrinsic to economics" reasons."

In 1940, von Neumann and Morgenstern formally and publicly recognised economics as a science followed by the Bank of Sweden, which instituted a Prize in Economic Sciences in memory of Alfred Nobel in 1968. In 2004, The Royal Society recognised economics as a science by the election of Sir Partha Sarathi Dasgupta, an economics professor at Cambridge, as a fellow. As Professor Cowen puts it, "I guess the reason that I think economics is a science is that empirical testing is a huge part of economics, i.e., if economics were only about the mathematical models, without falsifiable claims, I would agree it's not scientific. But economics makes

falsifiable claims all the time and tests them frequently. And some are confirmed repeatedly, and they become accepted wisdom. Others are falsified, and they fall by the wayside. Isn't that what science is all about?" To recapitulate, economics is an observational social science that is increasingly becoming an experimental science in its core – market analysis (see Kagel and Roth, 1995).

The Preconceptions of Economic Science

Almost from its beginning, economics has been viewed as a morally flawed discipline, even if an important one. Probably the most stinging rebuke was hurled in 1849 when Thomas Carlyle referred to economics as "the dismal science", (Lee and McKenzie). Economics (as Political Economy) is founded by a moral philosopher and major developments are led by mostly non-economists (physicists, mathematicians, engineers, medical scientists, biologists, chemists, statisticians, etc.) such that people query why it is not one type of science or another. Some, for example Alvey (1999), believes that economics is a moral science. Admittedly, Adam Smith tended to develop economics as a moral science and up to the beginning of the twentieth century many envisioned economics as a moral science, in theory and/or in practice. Economics is not moral beyond specifying the rules of the game and creating a level playing field for all players. Further, the emergence and influence of positivism in economic analysis has reduced the content of values in theory. This is not to argue that economics is free from ethical concerns, certainly normative economics is not. For this reason some ethical standards are required. But, the essence of production economics is that all activities that create utility for someone else is productive. This statement does not have so much regard for legality and morality of actions of economic agents. Property rights, their protection and enforcement fill the gap. However, Levitt and Dubner

(2006: 11) argues that “if morality represents how people would like the world to work, then economics shows how it actually does work.”

In 1898, Veblen asked the question: "Why is Economics Not an Evolutionary Science?" addressing M.G. de Lapouge's statement to the effect that "Anthropology is destined to revolutionise the political and the social sciences as radically as bacteriology has revolutionised the science of medicine." In so far as he speaks of economics, the eminent anthropologist is not alone in his conviction that the science stands in need of rehabilitation. Veblen himself did not buy into the criticism (see in particular Veblen (1899)) but thought that postulating an economic science should rely more on the analysis of economic change rather than being a simple taxonomy of axioms and – more or less rigorously drawn logical conclusions. This some interpret as a critique of the dogmatism in and the static nature of economic theory (see Kapeller, 2007). This, however, is an interpretation that Veblen rejects. The history of economic thought reveals that the development of the schools of thought and methodology in economics is recognition of change in the economy requiring new insights and explanations.

Kapeller (ibid.) revisits the Veblen question believing that economic analysis is locked into an ahistorical conceptual framework. It is also revisited by Saad (2009) in reviewing Shermer (2008), *The Mind of the Market: Compassionate Apes, Competitive Humans and Other Tales from Evolutionary Economics* that addresses ways by which evolutionary theory and biological formalisms might inform economic analysis? My question is what else economics is after the evolutionary spiral in the many dimensions that it has grown through time and space as exemplified by the partial historical narrative in section 3 above. It has evolved from the

science of household affairs to that of the modern nation state as we know it.

It is intriguing that while a good number of people are criticising physics imitation, which some extremists have derogatorily dubbed “physics-envy”, physicists are busy addressing questions of economic organisation and function suggesting new approaches to economics and broadening the scope of physics, (see Farmer et al (2005) *Is Economics the Next Physical Science?*). A good number of physicists are actively involved in an emerging field of econophysics, and two new journals and frequent conferences are devoted to the field, they reported. Besides, Physics departments worldwide are granting PhD theses for research in economics and in Europe several professors in physics departments specialise in econophysics, the report continued.

Econophysics is an interdisciplinary research field, applying theories and methods originally developed by physicists in order to solve problems in economics, usually those including uncertainty or stochastic processes and nonlinear dynamics. Its application to the study of financial markets has also been termed statistical finance referring to its roots in *statistical physics* (Wikipedia, 2009). Most recent history dates it to the mid 1990s because that is when several physicists working in the subfield of *statistical mechanics* decided to tackle the complex problems posed by economics, especially by financial markets. The term “econophysics” was coined by H. Eugene Stanley in the mid 1990s, to describe the large number of papers written by physicists on the problems of (stock) markets that first appeared in a conference on statistical physics in Calcutta in 1995 and the publication that followed. The inaugural meeting on Econophysics was

organised in 1998 in Budapest by Janos Kertesz and Imre Kondor (ibid.).³²

However, analogies in physics influenced the development of economic theory way back to the 18th century. If "econophysics" is taken to denote the principle of applying statistical mechanics to economic analysis, as opposed to a particular literature or network, priority of innovation is probably due to Farjoun and Machover (1983). Their book *Laws of Chaos: A Probabilistic Approach to Political Economy* proposes dissolving (their words) the transformation problem in Marx's political economy by re-conceptualising the relevant quantities as random variables. If, on the other hand, "econophysics" is taken to denote the application of physics to economics, one can already consider the works of Léon Walras (1694-1774), Daniel Bernoulli (1700–1782), Pierre-Simon Laplace (1749-1827), Joseph Fourier (1768-1830), Vilfredo Pareto (1848–1923) and Irving Fisher (1867-1947) as part of it. Bernoulli introduced the idea of utility to describe people's preferences, while Laplace in his *Essai Philosophique sur les probabilités* (1812) pointed out that events that might seem random and unpredictable such as number of letters in the Paris dead-letter office can be quite predictable and can be shown to obey simple laws. Laplace's ideas were further amplified by Lambert Adolphe Quetelet (1796-1874), who was a student of Fourier and who studied the existence of patterns in data sets (data mining) ranging from the frequency of different methods for committing murder to the chest size of Scottish men. It was Quetelet, who, in 1835, coined the word "social physics".

Indeed, as shown by Ingrao and Israel (1990), general equilibrium theory in economics is based on the physical

³² This discussion is taken from or depends extensively on <http://en.wikipedia.org/wiki/Econophysics> and Farmer et al (2005).

concept of mechanical equilibrium. It should be noted that econophysics has nothing to do with the "physical quantities approach" to economics, advocated by Ian Steedman and others associated with Neo-Ricardianism.

The practitioners applied tools and methods from physics - first to try to match financial data sets, and then to explain more general economic phenomena. One driving force behind econophysics arising at this time is the availability of huge amounts of financial data, starting in the 1980s. It became apparent that traditional methods of analysis were insufficient - standard economic methods dealt with homogeneous agents and equilibrium, while many of the more interesting phenomena in financial markets fundamentally depended on heterogeneous agents and far-from-equilibrium situations.

The basic tools of econophysics are probabilistic and statistical methods often taken from statistical physics. Models of Physics that have been applied in economics include percolation models, chaotic models developed to study cardiac arrest, and models with self-organising criticality as well as other models developed for earthquake prediction. Moreover, there have been attempts to use the **mathematical theory of complexity** and *information theory*, as developed by many scientists among who are Murray Gell-Mann and Claude E. Shannon, respectively. Since economic phenomena are the results of the interaction among many heterogeneous agents, there is an analogy with statistical mechanics, where many particles interact; but it must be taken into account that the properties of human beings and particles significantly differ. Besides, the extreme complexity of social phenomena ensures that there are also differences in goals and philosophy. Physicists go for universal laws, while contemporary economists are driven by relativists' philosophies of science

that have gained widespread acceptance such that work in social science is increasing focusing on change, (ibid.).

There are, however, various other tools from physics that have so far been used with mixed success, such as fluid dynamics, classical mechanics and quantum mechanics (including so-called classical economy and quantum economy), and the path integral formulation of statistical mechanics. There are also analogies between finance theory and diffusion theory. For instance, the Black-Scholes equation for option pricing is a diffusion-advection equation. Given the many analogies and overlaps, the range of topics that have been addressed by physicists traverses many different areas of economics and finance. The sample includes empirical observation of regularities in market data, the dynamics of price formation, the understanding of bubbles and panics, methods for pricing options and other derivatives and the construction of optimal portfolios. Broader topics in economics include the distribution of income, the emergence of money and applications of symmetry and scaling for market functioning (ibid.).

Given the many opportunities, Farmer et al (2005) predicts that in the next few years some physics and economic departments will design a basic course teaching the essential elements of both physics and economics, which points to the possibility of combined honours degree programmes in these fields. They believe that union of methods of physics and economics and collaboration between physicists and economists can add value to the sciences of economics and physics.

A Mathematical or Economic Science?

Mathematical economics refers to the application of mathematical methods to represent economic theories and analyze problems posed in economics by mathematical logic

and reasoning. It allows formulation and derivation of key relationships in a theory with clarity, generality, rigour, and simplicity. Mathematics allows economists to form meaningful, testable propositions about wide-ranging and complex subjects which could not be adequately expressed informally. Further, the language of mathematics allows economists to make clear, specific, positive claims about controversial or contentious subjects that would be impossible without mathematics. Much of economic theory is currently presented in terms of mathematical economic models, a set of stylized facts represented in simplified mathematical relationships that clarify assumptions and implications.

Formal economic modelling began in the 19th century with the use of differential calculus to describe and predict economic behaviour arising from small changes in the forces at play popularly known as the Marginalist Revolution. Economics became more mathematical as a discipline throughout the first half of the 20th century, but it was not until the Second World War that new techniques would allow the use of mathematical formulations in almost all of economics. This rapid formalisation of economics analysis alarmed critics of the discipline as well as some esteemed economists. Their ranks included John Maynard Keynes, Robert Heilbroner, Friedrich Hayek and others who criticized the broad use of mathematical models for representing human behavior, arguing that some human choices are irreducible to arbitrary quantities and/or probabilities. The question then arises, what happens to the portions of economic analysis to which mathematics is relevant? Yet, the use of mathematical representation of economic relationships does not in any way make economics a mathematical science as Weintraub (2002) would want us to believe. It only created a discipline Mathematical economics.

An Economic Science

In my view, economic is both a theoretical and applied social science that uses mathematics as one of its languages of presentation and communication. After all, economics is only one area of the many applications of mathematics. The touchstone of science as it is commonly know, is its methodology not its conclusions. The scientific method is what makes science respectable. But the scientific method also has a serious draw back in that it is not capable of studying everything. In its narrow interpretation, it entails adherence to the scientific method as the sole standard; i.e. accepting what it endorses and rejecting what it rejects, (Erfan Shafey, 1983). Happily, contemporary methodology of economics is reasonably compliant to the scientific method. Yet, there are other sciences that can not adopt the scientific method; cases in point are astronomy and evolutionary biology. It follows that the question regarding whether or not economics is a science is foreclosed.

How Many Economic Sciences?

Some writers ask all sorts of questions. For example, some ask, why is economics not an evolutionary science (example (Lapouge, 1897))? Others ask why economics is not yet a pluralistic science (example Davis (2007)). Still others ask how can economics be an inductive science (example Hoover (2008))? These questions are all part of the obloquy (humiliation) that economic science has been subjected to in time and through time. The natural fact is that every science evolves through time (and possibly across space) and passes through stages of development and economics is no exception. Economics has developed in a variety of directions – conceptions, schools of thought, methodology and scope (disciplines). Beginning as “a science of housekeeping” in the writings of the ancient Greek philosopher Xenophon to that of

the Caliphate to political economy as an aspect of moral philosophy and one of the moral sciences to an independent mainstream (neo-classical) economics represent extensive evolution through time.

Precisely wherein economics fall short of being an evolutionary science is not so plain as Veblen (1898) rightly noted. Even as in 1897 it cannot be said that economics was helplessly behind the times, and unable to handle its subject matter in a way to entitle it to stand as a modern science as claimed by (Lapouge, 1897). To ask, if economics has reached a definitive formulation even by 1897 is to be oblivious of the extensive achievements in economic analysis transforming it from a topic in philosophy to political economy and into economic science as we know it currently in conception, scope and methodology. Agreed the sciences are at different stages of development, yet, every science stands in need of rehabilitation as long as it has not reached its summit of development. Every science is still evolving going through stages of historical development, breaking new frontiers, discovering and analysing new and emerging scenarios, and opening black boxes to investigate details in finer units and economics is no exception. Economics has evolved in the last 3,000 years or so in the various dimensions and forms it has been discussed.

The origins of economic science as sketched in **Section 2** shows that economic thought has evolved from the idiosyncrasies of the ancient social concepts of “Household theory” to economics of the Caliphate to economics of the modern nation state as we know it currently. And by schools of thought it has evolved from the ancients disquisition to the discourses of the Scholastics to Mercantilism to Physiocracy to the Political Economy to Classicism to Marxian or radical (Socialist) economics to Geo-classical economics to the Austrian school to Marginalism to Institutionalism of the

Americans to Keynesian interventionist economics to neoclassical synthesis to Neo-Classical economics to Post-Keynesian economics to the modern Austrian school to Foundational economics to the heterodox school to economic methodology (neo-positivism) – Popper, Kuhn, Lakatos, Feyerabend and Bayesian updating. Economic theory has thus evolved from mercantilism to neo-positivism. Though, evolutionary economics does not take the characteristics of either the objects of choice or of the decision-maker as fixed as mainstream economics. Rather its focus is on the processes that transform the economy from within and their implications for firms, institutions, industries, employment, production, trade, and growth. The processes in turn emerge from actions of diverse agents with bounded rationality who may learn from experience and interactions and whose differences contribute to the change.

These developments in themselves show that economics is a pluralistic science in the sense that there are different schools of thought with different methods for understanding systems. Further, by the Journal of Economic Literature classification there are twenty-six (26) broad areas of study in economics and about 120 disciplines or areas of specialisation, some of which are further divided. Even if pluralism is interpreted as a vision of professional interaction (open systems of thinking and methodology) in research and pedagogy, this too is a growing phenomenon in economics analysis in particular in heterodox economics and even mainstream economics is no longer an exception. If, in particular, the reference is to analysis of economies as evolving, socially influenced and constructed, and politically governed systems and the ways in which economic thought is affected by and affects the dynamics of real economies, then, many branches of economic analyses are pluralistic. Thus, it is

pertinent to ask, how else could a science be evolutionary and pluralistic?

Clower (1994) is an indictment of economists who teach any kind of "pure" theory whether it is microeconomics or macroeconomics, where pure theory is defined as the axiomatically-based neoclassical approach to economic analysis as opposed to "theory" referring to "fact-oriented creative mixture of intuition, casual empirical knowledge, and seat-of-the pants logic that is found in virtually all "applied economic analysis" and, indeed, in virtually everything called "economics" before 1950." Even though, the notion "economics" is polyhedral; encompassing economic system, economic science (theory) and economic policy; the primary notion of economics is mostly empirical, experienced, which forms under the influence of, the mass media, in which it is said about the prices, income, salary, satisfaction, need for goods and service that are equated to economics.

Reiss (2008) while agreeing that economics is awash in data, and the vast majority of published articles are empirical is never the less agitated by the question, how economics can be made into an evidence-based (or at least a more evidence-based) science? In a nutshell Reiss (2008) was speaking to the limitations posed by the evidential base of economics, in particular, the possibility of the defeasibility of prima facie evidence, the relativity of evidence to particular purposes, and the issue of values in data design and construction with implications for results, interpretation and uses. This is well known and acknowledged and is being tackled vigorously by methods that go beyond the natural or historical experimentation to the methodologies of experimental economics. Thus, the prospects for evidence-based economics are great as Reiss himself realises. Even if, economics science tends towards the epistemic dimension of science i.e. the collection of knowledge for its intrinsic sake, econometrics has

a role in drawing economics into a more non-epistemic or applied direction.

Data, however, do not speak for themselves with implications for the claims to knowledge meaning that even if tentative or mere conjectural, some form of theoretical account is required. In other words, data need to be understood with respect to their properties, interpreted for what they stand for and their formation explained. These raise issues regarding the two principal approaches to explanation, namely, deductivism (methods of a scientific abstraction – from the general to individual or particular cases) and inductivism (history and logical approach – from individual or particular cases to the general).

Fortunately, these procedures are not as mutually exclusive as it is sometimes thought. Rather, deductivism and inductivism complement and reinforce one another. Admittedly, while mainstream neoclassical economics practices largely deductivism, econometrics and case studies endorse inductivism beyond approving of empirical testing of the conclusions of a priori theories (deductivism). In practice induction adds weight to the conclusions of a priori theory or forces it to reformulate (see Figure 10). After all, Boylan and O'Gorman observed "Description, theory and observable causal webs are domiciled in the epistemic domain of science, and explanation is housed in the non-epistemic domain." Thus one can picture a 'scientific' continuum, and at one end of the scale pure epistemic science, and at the other end is the non-epistemic or applied sciences. One might now ask where economics lies on this continuum? Further, in time and space, both historical experiments and methodological advances in areas such as data mining, panel data construction, and experimental economics are ever expanding and deepening the database for economic analysis. Agreed, the wider and deeper

and more prima facie the database is the better for economic analysis.

A Bankrupt Science?

Is economics broke, insolvent, ruined or busted? Beginning in the 1970s with the breakdown of the postwar Keynesian paradigm (see Coleman, 2003), titles such as “Economics: A Bankruptcy Science?” (Klamer, 1989); “The Death of Economics” (see Ormerod, 1994); “The “Principles of Economics: Some Lies My Teacher Told Me” (see Boland, 1995); “The Decline of Economics” (Cassidy, 1996); “Against Economics” (see Kanth, 1997); “Debunking Economics” (Keen, 2001); “The Economy and the Economics Profession – Both Need Work” (Bergmann, 200x)³³ and “Why Economics is Bankrupt as a Profession – an Explanation” (Paul Krugman, 2009) among others began floating. Also, one meets these kinds of reactions in staff clubs and street corners, where economics and economists are held responsible for everything wrong in the economy and in the lives of people, who had failed in one sense or another. All these imply that economics as a science is bane. But, is economics that “harmful” or “pernicious”? It needs be said, that every science has its areas of worries depending on its level of development. Any science that has no concerns has outlived its usefulness and should be buried. It is comforting to note that all the contents of the above titles added together, the answer to the above question is in the negative. Intriguingly, none of the above titles speak to what their title implies, except perhaps for Bergmann, (200x).

Ormerod (1994) does not imply that the study of economies is not of great importance but rather he argues that conventional economics (neoclassical orthodoxy) offers a

³³ Cited in Colander, 2008.

misleading view of how the world operates and needs to be replaced. This is simply an opinion. There is nothing wrong in preferring a particular approach to an issue or holding on to a view in a social setting. There are different ways of viewing economic events in a social world but to insist that one's view is the only correct way is **arrogance**.

Economics and economists are criticized and critiqued on different counts from both inside and outside. Worse still even economists criticise each other. Most intriguing is that even some of the "Big Wigs" of the profession are themselves criticizing and critical, their ranks include Fredrick Hayek, John Hicks, Robert Heilbroner, Mark Blaug, McCloskey and most recently Barbara Bergmann and Paul Krugman among others. Hayek in his "The Pretence of Knowledge" asks whether there really has been steady cumulative progress as economic laws are discovered and improved empirical methods introduced. His own work on microeconomics made him extremely doubtful. Caldwell (2003) echoes Hayek in believing that the most that economists, like other social scientists, can hope to achieve is pattern predictions. But, that in itself is a major achievement.

Mainstream neoclassical economics is criticised for being a 'closed system', i.e. as a science which maintains a restrictive interpretation of the economic aspect of reality, and therefore ignores nearly all the potentials to the opening-up process of this aspect. The features of this restrictive interpretation of reality in economics - which interpretation has its root in the humanistic idea of the autonomy of human reasoning - are 1) the adherence to formality and types of functionality and causality, which belong to the natural sciences (to obtain so-called 'neutral' scientific statements about 'objectively determined laws'); 2) the transformation of living subjects to atomized individuals, loosened from their - normatively qualified - societal structures; 3) a deliberate

restriction of the field of knowledge to those 'facts' which are open to a positivistic approach; 4) the elimination of any anticipation to the other normative aspects of reality; 5) rational choice theory in economics makes unrealistic simplifying assumptions about human nature and does not capture the importance of human rights and concerns for distributive justice; and 6) essentially, the "first-best" neoclassical analysis fails to properly account for various kinds of general-equilibrium feedback relationships that result from intrinsic Pareto imperfections among others.

First, a theory is not supposed to be tautological reproducing reality. It will simply be boring. It should, however, be a reasonable metaphor of reality. It follows that assumptions can only approximate reality. Besides, mainstream academic economics is far from being the only source of modern economic ideas and methodology. Further, policy is a normative judgment of what is (the extant world) in the negative, i.e. the extant world is judged not good enough. This invariably implies the existence of some Pareto superior states to the extant state. In other words, there is room for Pareto improvement and more importantly that a Pareto optimal state is yet to be achieved. This fact motivates the search for not just a Pareto optimal state but the "bliss solution" – i.e. a state in which society is reconciled into a 'happy state'. Therefore, **policy making, implementation, effectiveness and outcomes may be viewed as a journey from what is to what ought to be.** Thus, policy is a campaign for change, hopefully for the 'best'. So, the critical issue or question to pose is **what is the knowledge base** about the extant state? This is where science fits into the schema to provide explanation and by implication predict consequences.

The development of economic science shows in many respects one or more of these features. This can be illuminated by the transition from scholastic economic thought to the

approach of the classicists – which latter, for instance, tries to make the idea of a just price into an empty formula, and interprets the idea of 'economic surplus' in an utilitarian manner as an aggregation of individual atoms of happiness (the greatest happiness for the greatest number). Another illustration is the classic doctrine of the 'circle of data'. Economic data are chosen in a very concise way, namely to restrict the economic inquiry to market- and price- phenomena; which can be made accessible to types of analysis that are purely based on ideas of mechanical functionality and causality, with or without an appeal to the probability-calculus. The result of such an approach is that economic effects outside the market - for instance disturbances to human health and environmental qualities by air and water pollution - are excluded from the field of knowledge of 'pure' economic theory. But there are still more far-reaching consequences. Economic theory itself has to face the challenge of a disintegration of its theoretical foundations, because the whole range of economic data is staggering.

Given the growing complexity of modern economy, the classic data (human preferences, nature, technical knowledge, and so on) are so deeply influenced by economic influences, that they can in fact no longer be used as real starting points for any economic analysis. Economic science is therefore confronted with a dangerous crisis of its foundations, which has its root primarily in its restrictive 'closed' set up. It is argued, this crisis takes the form of a dilemma between a borderless extension of economic theorising, stimulated by the desirability of a 'full' explanation of economic data, on the one hand, and the rejection of the universal validity of mathematical and physical causality-types in social sciences on the other hand. However, any explanation of an event assumes causality of some sort, realised or not. The idea of causality in economic science, which is orientated towards the normative

structure of the economic aspect of reality, is not out of place. Any other choice will probably lead to a real loss of internal unity in economic science, and will pull down any real resistance against the invasion of full pragmatism in economic theory.

Further, some remarks have been made about the damaging influences of restrictive economic theorising for the development of human society. Among these influences can be mentioned: the wrong interpretation of business enterprise as a unit of organisation of mere 'factors of production'; the devaluation of the evil of inflation to a mere 'technical' engineering problem for economic 'experts'; the interpretation of market-transactions as 'ethically-neutral'; the lack of balance in human civilization between the desire for market goods and scarce non-market-goods, which lack of balance has caused a disharmonious over-exploitation of non-priced natural resources, which have been treated as having no economic value at all.

There is the issue of increasing rigour and discontent, which is a paradox. Some say economics is not scientific, others argue it should be scientific, and yet, still others say it should not be rigorous. **Mainstream neoclassical economics is criticized for being axiomatic deductive proposition** based on Bourbakian mathematics, specifically real analysis, deductive proofs, theorems and lemmas. For this reason Blaug (1997) thinks, modern economic analysis is sick and nothing more than an intellectual game played for its own sake and not for its practical consequences for understanding the economic world. Asserting that economists have converted the subject matter into a sort of social mathematics in which analytical rigour is everything and practical relevance is nothing. But, a different position is possible. The study of abstract idealised states of the economy is not without its values or usefulness. It provides most directly normative judgements of institution

building and the directions for improvement within a comparative paradigm.

Further, a little reflection shows that the level of mathematics in economics is dictated by two factors, namely, the inadequacy of simpler mathematical methods to handle given problems and the increasing complexity of modern economy. Tables of numerical examples only speak to the intuition, provides no proof whereas explanation requires causality, which motivates the search for appropriate functionality; the requirement of equal number of equations as unknowns is a limitation of algebra and the issues of inequalities and corner solutions make linear programming relevant; the inability of calculus to handle kinks, holes and other forms of discontinuity makes set theoretic approaches relevant. Economic dynamics call for optimal control techniques and hence calculus of variation. Game theory is an extremely versatile theory to practical use in economics, in particular in behavioural economics and insurance. It is indeed indispensable in the design of public auctions. So, where lays the problem? Admittedly, **there are pitfalls and outright abuses in the use of mathematics in economics but none of these invalidate its use in economic analysis.** After all, behaviour, innovation, herd mentality, bubbles, and even madness can be modelled in equations (Jalex, September 9, 2009). The real issue, then, is not how much mathematics to use and when, but what kind and where. Mathematics is essential to science and a very useful tool in describing the universe, in particular, if used appropriately and sensibly.

The mathematical theory of statistics has been revolutionized. New and rich stores of statistical data have come into being, and an impressive body of empirically derived generalisations about economic life and its vicissitudes has been developed. The gain in analytic and computational equipment and tested knowledge has been considerable, but

the knowledge gained is still judged woefully inadequate to meet society's needs. How can the standard of living of the masses be raised? By what devices can a free society maintain a high and steadily rising level of employment? What are the economic prerequisites of permanent peace and how can they be realised in practice? To these fundamental and many other socioeconomic questions such as inequality, poverty and suppression or discrimination, economists continue to give conflicting answers. Thus, it is not surprising that the issue of 'a just Nigerian society' was the worry of Okowa (2005).

Most of the criticisms of economic science have their origins in epistemological and methodological grounds as well as in its capacity to express the deep socio-political and economic mutations through time and space (see Bucur (200x)). However, the criticisms are not new. From its beginning, the methodology of economic science has been debated. They are echoes of criticisms that were directed against political economy, Ricardo [1772-1823] and Mill (1773-1836) and then neoclassical economics from its beginnings with Walras (1834-1910), William Jevons (1835–82) and Carl Menger (1840–1921) among others. But, the pertinent question is, **would the world be much better off without economics?** This question really centres on the social relevance of economic analyses, which in turn borders on methodological issues as well as in its capacity to express the deep socio-political and economical mutations in time and across space as noted earlier. Yet, all the criticisms of economics added together, the answer the above question is in the negative. Many of the titles mentioned above and the many others not mentioned simply claim that economics as an academic field fail to speak to the actual, daily, fruit-selling, labor-buying, contract-making economy by the language and communication framework it uses whereby the meaning of the message in economics has been left aside and sadly enough,

the economist has not much to say at that point. Protesting does not help either.

True, in the 1970s, economics had serious problems; neither theory nor empirical work was on solid footing. But, what was required was adjustment of conceptual and analytical (theoretical) framework; re-examination of some its postulates and assertions; and opening up to political and social relations within the social context the economy operates. Happily, modern economics has responded positively to many of the criticisms levelled against economics and economists. Modern economics as Colander (2008) puts it, is plurodoxy – an eclectic mix of approaches that includes traditional neoclassical microeconomics, game theory, high-tech data mining, mechanism design, behavioral economics, experimental economics, association of cultural economics (ACE) modeling, and neural economics, just to name a few of the many research programmes. Economics has become an essential tool for understanding the complexities of modern society. What defines modern microeconomics is its approach — one which identifies problems, translates them into incentive-based models, and takes the models to the data within a milieu of natural experiment, or designing a lab or field experiment or some combination of these. Further, macroeconomics now analyzes more than just the monetary forces that have shaped societies. Macroeconomic science and macroeconomic engineering had become better integrated for practice in the recognition that practice without theory is blind and theory without practice is empty.

The Economists' Way of Thinking

Every field of study has its own language and its own way of thinking. Mathematicians talk about axioms, integrals, and vector spaces. Psychologists talk about ego, id, and

cognitive dissonance. Lawyers talk about venue, torts, and promissory estoppel.

Economics is no different. Supply, demand, opportunity cost, elasticity, comparative advantage, consumer surplus, deadweight loss are part of the economist's lexicon. These and many other terms and some familiar words that economists use in specialised senses are often encountered. For the uninitiated, this new language may seem needlessly arcane. But, its value lies in its ability to provide a new and useful way of thinking about the economic world in which we live in a special way. Economics is an observational/experimental social science that utilise the logic of the scientific method to examine how individuals and the economy works. Its interface with mathematics reflects developments in both mathematics and economics and in the professional communities over time. The respective histories of these disciplines are intertwined, so that both developments in mathematical knowledge and changing ideas about the nature of mathematical knowledge affected changes in the methods and concerns of economists and affects their culture, in particular their language. The converse is also true and in particular with applied mathematics but there could be no applied mathematics without pure mathematics.

Thinking like economists simply asks a number of questions. How do economists process economic facts? What principles do they use? What insights do they gain? And how do their insights influence public policy debates for the good of the whole? A fundamental belief in economics is scarcity meaning that the desire for resources to meet human wants is relatively inadequate. The consequences of this are individual choices and social competition as summarised in Figure 11.

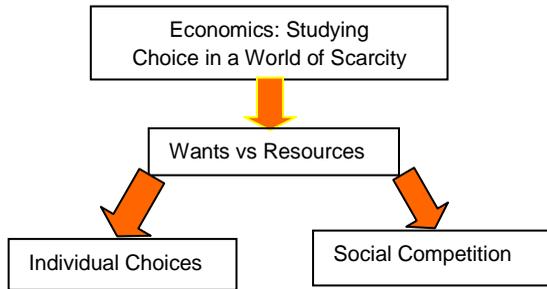


Figure 11: Economists Basic View of the World
Source: Joseph Henry Vogel, 2009

Another belief is that economic agents are rational persons, i.e. they have an objective function aimed at achieving the best or the greatest value and furthermore their behaviour is goal directed, namely, purposeful. This is why economics train you to be mindful about the choices that you make and advise you to evaluate the cost of individual and social choices. Examine and understand how certain events and issues are related and you are well advise to consider the cost-benefit of each activity or decision when making decisions, since trade-offs are involved. An individual (or a firm, or a society) should take an action if, and only if, the extra benefits from taking the action are at least as great as the extra costs. **If the marginal benefit exceeds the marginal cost, then jump at it!**

Models in Economic Analysis

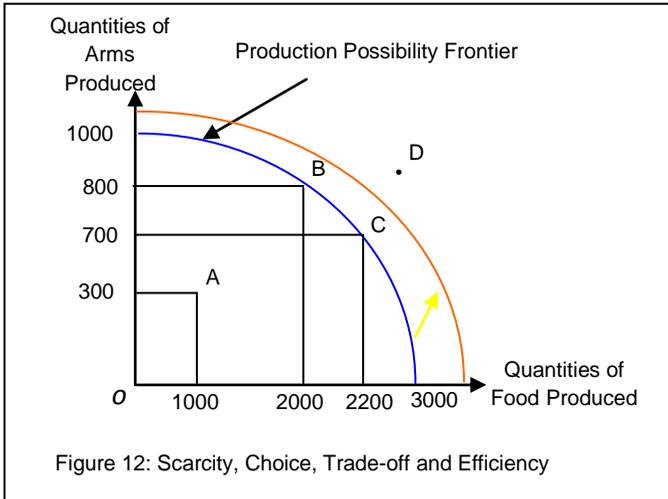
Economists as scientists try to address their subject with a scientist's objectivity. They approach the study of the economy in much the same way as a physicist approaches the study of matter and a biologist approaches the study of life. They devise theories, collect data, and then analyze the data in an attempt to verify or refute their theories. This is not to claim that economists work with test tubes or telescopes. The

essence of science, however, is its methodology — the dispassionate development and testing of theories about how the world works. Thus, the Scientific Method involves observation, theory, and more observation and continued testing. This method of inquiry is as applicable to studying a nation's economy as it is to studying the earth's gravity or a species' evolution. As Albert Einstein once put it, "The whole of science is nothing more than the refinement of everyday thinking" (see Vogel, 2008)

However, economics is not a natural science such as physics, so most people are not accustomed to looking at society through the lens of a scientist. How then do economists apply the logic of science to examine how an economy works? Assumptions play an important role in all fields of analyses including the natural sciences. They greatly simplify the complex of reality and make it easier to understand without substantially affecting the answer. A fundamental assumption in economic analysis is the scarcity principle also called the "No-Free-Lunch" principle. It means that although there are boundless human needs and wants, the resources available to meet them are limited. So having more of one good thing usually means having less of another. This is the significance of the necessity for choices in Figure 11 and the social competition and tension that arise therefrom. It should be noted that economists use different assumptions to answer different questions when studying the short-run and long-run effects of changes in economic variables.

Just as secondary school biology teachers teach basic anatomy with plastic replicas of the human body containing all the major organs — the heart, the liver, the kidneys, and so on or as geographers use the map of the world for the physical description of planet earth. Economists also use economic models, which show in a simple way how the important parts of the economy fit together and produce the observed patterns

or outcomes. But, unlike a biology teacher’s plastic model, the economists’ models are most often composed of equations and their images in diagrams. No one model includes all features of what is being modelled; usually some (irrelevant) details are assumed away. Therefore, all models are true and false at the same time but some are very useful.



One good example of a model is the concept of production possibilities frontier (curve), [PPF = PPC] concept, which illustrates the concepts of economic efficiency, tradeoffs, opportunity cost and economic growth. In economics benefits are measured as the difference between the maximum you would be willing to pay for something rather than do without it and the subjective value you place on that thing called **economic surplus**. The measure of cost is not just the financial cost of what is bought or done. But, rather the **opportunity cost** of an activity, which is the value of the next-best alternative that must be forgone (sacrificed) in order to undertake the desired activity. The choice criterion, therefore,

is choosing those actions that generate the largest possible economic surplus. Sometimes people don't behave rationally, but economics can help them to make better decisions. Since some actions involve sacrifices that are not visible or implicit, some people do not accurately account for cost of an action by ignoring these hidden or implicit costs. Such actions make for inefficient decision.

An outcome is said to be efficient if the economy is getting all it can from the available scarce resources. Points on (rather than inside) the PPF represent efficient levels of production. When the economy is producing at such a point, say point B, there is no way to produce more of one good without producing less of the other. Point A represents an inefficient outcome. For some reason, perhaps widespread unemployment, the economy is producing less than its full potential from the available resources. It is producing only 300 units of arms and 1,000 units of food. If the source of the inefficiency were eliminated, the economy could move from point A to point B increasing production of both arms (to 700) and foods (to 2,000).

The unrealistic bit of the PPF in Figure 12 is that real economies produce millions of goods and services but Figure 12 imagined an economy that produces only two goods — arms and foods. Together the arms industry and the foods industry use all of the economy's factors of production. The PPF is a graph that shows the various combinations of outputs — in this case, arms and foods — that the economy can possibly produce given the available factors of production and the state of technical-know-how (technology) that firms can use to transform the factors of production into outputs. In this theoretical economy, if all resources were fully utilised in the arms industry, the economy would produce 1,000 arms and no foods. If all resources were used in the foods industry, the economy would produce 3,000 units of foods and no arms. The

two end points of the PPF represent these extreme possibilities. In between these extreme points are infinite possibilities of different combinations of arms and foods to be produced utilising all available resources. For example, if the economy were to divide its resources between the two industries, it could produce 700 cars and 2,000 units of food, shown in the figure by point B. By contrast, the outcome at point D is not feasible because available resources and technology cannot sustain production at that level. The economy does not have enough factors of production with the technical-know-how to support that level of output. In other words, the economy can produce at any point on or inside the production possibilities frontier, but it cannot produce at points outside the frontier.

The limitations of models, notwithstanding, they are used to examine various economic issues with underlying assumptions. Another important example is the circular-flow diagram. The economy consists of millions of people engaged in many activities — buying, selling, working, hiring, manufacturing, and so on. To understand how the economy works, we must find some way to simplify our thinking about all these activities. In other words, we need a model that explains, in general terms, how the economy is organised and how participants in the economy interact with one another. Figure 13 presents a visual model of the economy, that of a circular-flow diagram. In this model, the economy is simplified to include only two types of decision-makers — households and firms. Firms produce goods and services using the four broad categories of factors of production, namely, labour, land, capital (buildings and machines) and entrepreneurship. It is further assumed that households own the factors of production and consume all the goods and services that the firms produce.

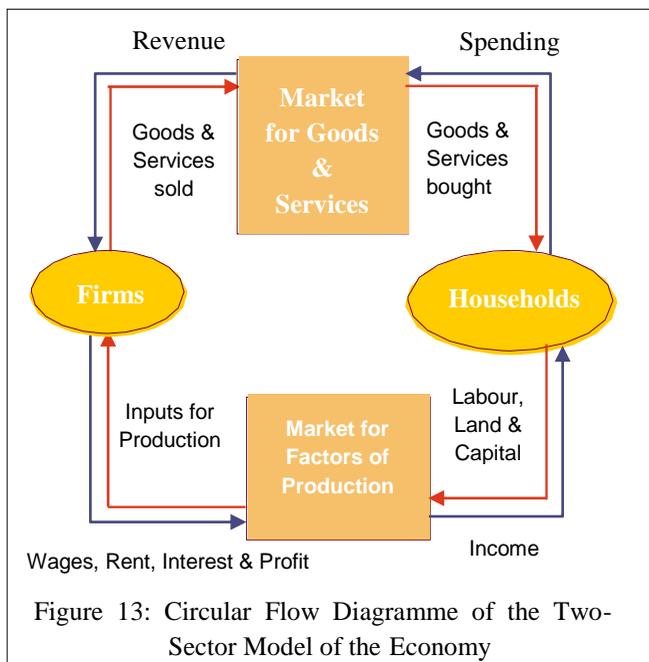


Figure 13 is a schematic representation of the organisation of the economy. Decisions are made by households and firms. Households and firms interact in the markets for goods and services (where households are buyers and firms are sellers) and in the markets for the factors of production (where firms are buyers and households are sellers). The outer set of arrows shows the flow of money (naira), and the inner set of arrows shows the corresponding flow of inputs and outputs. The circular-flow diagram offers a simple way of organising all the economic transactions that occur in the two-sector model between households and firms in the economy. A more complex and realistic circular-flow model of the economy would include, for instance, the roles of government and international trade. Even such a model still provides only a simplified view of the economy, dispensing

with details that, for some purposes, are significant. Yet, details are not always crucial for a basic understanding of how the economy is organised. Given the simplicity of the circular-flow diagram, it is useful to keep in mind when thinking about how the pieces of the economy fit together that some details are omitted.

Levels of Economic Analysis

Many subjects are studied at various levels. For example, biology is studied at molecular and cellular levels investigating the building blocks of living organisms while evolutionary biology studies the many varieties of animals and plants and how the species change gradually over the centuries. Economics is also studied at various levels. The main divisions are microeconomics and macroeconomics – concepts borrowed from biology and used in a generic sense. Microeconomics takes a microscopic view of economic activities studying decisions of individual households and firms (in general parts of the economy). In a fuller sense, it studies the interaction of households and firms in markets for specific goods and services. While macroeconomics takes a telescopic view studying the operation of the economy as a whole, which is just the sum of the activities of all the decision-makers in all the markets of the economy.

Microeconomics and macroeconomics are closely intertwined. Because changes in the overall economy arise from the decisions of the millions of individuals making-up the economy, it is impossible to understand macroeconomic developments without considering its microfoundations. Despite the inherent link between microeconomics and macroeconomics, the two fields are distinct. In economics, as in biology, it seems natural to begin with the smallest unit and build up. Yet doing so is neither necessary nor always the best way to proceed. Microeconomics and macroeconomics address different questions; they sometimes take quite different approaches and are often taught in separate courses.

Another separation in economics consists of positive economics (economics science) and normative economics (policy) corresponding to in philosophy “what is” and “what ought to be”, respectively. This division gives the economist two roles to play – scientist and engineer (the policy advisor), respectively. Positive economics attempts to describe the economic world as it is; while normative economics attempts to prescribe how the economic world should be, hopefully for the better. A key difference between positive and normative statements is how their validity is judged. In principle, positive statements can be confirmed or refuted by examining evidence. In contrast, evaluating normative statements involves values as well as facts such that deciding what is good or bad policy is not merely a matter of science. It also involves our views on ethics, religion, and political philosophy, so there is no straight forward answer. Thus, it is easy to understand why economists have many hands and often disagree with one another. Interestingly, positive and normative statements are related. Our positive views about how the world works affect our normative views about what policies are desirable. Yet normative conclusions are not simply derivatives of positive analysis alone; they involve value judgments as well on how best to improve how the economy works.

According to Shafey (1983) economic knowledge of cause and effect relationships principles tend towards the time-and-place bound guidelines of policy which are modifiable in the light of feedbacks, that is the role of values in the formulation of theory and design of policy. There can be no denial that some values are implicit and unavoidable in the formulation of positive theories (e.g. in the choice of problems and variables). But it does not follow that the analytical distinction between positive and normative economics is dead and useless. There is often a big and clear difference between "what is" and "what ought to be". Normative economics, in its primary concern with "what ought to be" cannot ignore "what is" the actual reality in a given time and place. In other words, normative economics needs theories or positive models by which actual reality can be comprehended, evaluated, and/or

steered to bring it closer to the normative model. It has been said earlier, theory without practice is empty and practice without theory is blind.

Do Economics have Useful Past, Present and Future?

Economics science has a twofold aim, namely, first to accurately describe economic events in both our present and past social orders and second, to furnish scientific explanations of these events. Conducting an economic analysis requires the application of scientific methods to break down economic events and phenomena into their separate components that are easier to examine in order to understand their structure involving 7 steps, namely, (a) identification of appropriate economic indicators; (b) collection of economic data; (c) analysis and preparation or selection of an economic model; (d) interpretation of the results of analysing economic data; (e) monitoring of intervening forces; attempt verification or refutation of the postulates or implications of the theories and (g) using the economic analysis for decision making. It is decision makers who use the results of an economic analysis for decision making.

Astute decision makers recognise that economic forces are uncontrollable and that current strategies may need to be adjusted to cope with or overcome obstructing economic changes. They approach with caution opportunities and threats discovered as a result of economic scanning and analysis. They pursue a proactive approach, knowing that economic analysis informs them of how best to choose from alternative approaches to employ scarce or uncommon resources and achieve objectives in the most efficient and cost effective manner. However, it must be noted that decision makers are largely politicians, i.e. even when they are economic professionals with focus on political, societal and other interests in applying economic science and engineering

(policy), which tamper with the application of economic principles in practice. This notwithstanding, it may be asked, what are the uses and possible uses of economic science?

Living entails a wide variety of activities. They include upbringing, education, medical service, rest, science, culture, production, distribution (exchange) and consumption. All these spheres of vital human activities are closely connected and form a united social system, which can be separated into three subsystems: **socio-cultural**, **politico-administrative**, and **economic** spheres. Each of these subsystems is an open system but is somewhat independent and has its own laws of functioning. The most important among these systems is the economic in the sense that it forms the base and provides all the peoples' vital activities to satisfy their material and spiritual needs. The other systems admittedly are supportive and influential and should not be ignored completely.

The concerns of the early economists involved a number of issues which they held in common, the answers to which are the basis of the structure of well-functioning societies today as much as in their days. These include how to make markets (in general institutions) work optimally, taxation policies to best cater for the collective needs of society, and other monetary instruments transparent and free from corruption; when is profit permissible (and how much) based on the labours of others, such as in the case of merchants, the charging of interest and when does it become unacceptable usury; and other practices that would otherwise destroy **the well-being of ordinary law-abiding people on which strong and unified states are built**. If this statement has any credence, then, Malthusian economics is a welcome wake-up call, alert, and privileged information to avoid a failed state.

The unity, simplicity, and power, even its subtlety, formality, high analytic thinking and ever increasing rigour utilising abstract mathematics with proof making

(mathematical truths), economics is attributed a leading role among the social sciences and a prominent position as contributor to economic and/or social issues in the real world.

Economic principles and methods applied to legal problems can illuminate and reveal the coherent system of laws. Economic reasoning can be applied to common law; property; contract rights and remedies; family and sex laws; tort; criminal law; jurisprudence; public regulation of the market; antitrust laws; regulation of employment relations (labour laws); public utility and common carrier regulation; the choice between regulation and common law; laws of business organisations and financial markets; corporations, secured and unsecured lending and bankruptcy; law and the distribution of income and wealth; taxation; the transmission of wealth at death (Will); the legal process; the market, the adversary system, and the legislative process as methods of resource allocation; the process of legal rulemaking and legislation into policy; civil and criminal procedures; law enforcement and the administrative process; the constitution and the system of governance; the nature and functions of constitutions; due process; nation building; racial or any type of discrimination, tribalism and ethnicity; the protection of free markets in ideas and religion; searches, seizures and interrogations among many others. There is economic analysis of legal rules and institutions including legal regulation of nonmarket behaviour such as drug addiction, thefts of art, sexual acts, surrogate motherhood, rescues at sea, flag desecration, and religious observances; which can be seen as a tool for understanding and reforming social practices, rather than as a formal system of daunting mathematical complexity, (Posner, 2002).

In engineering, economics is applied to finesse design and evaluate the feasibility of engineering projects. Indeed, this is true of any projects whatsoever. In science, there are bioeconomics, econophysics, ecology and environmental

economics among others. Bioeconomics discusses the vital issue of the economic value of biodiversity for individuals and society, while ecological and environmental economics deal with the economics of nonmarket uncommon resources and how to balance the desire for them with the desire of market goods and services. Econophysics is an interdisciplinary research field, applying theories and methods originally developed by physicists in order to solve problems in economics, usually those including uncertainty or stochastic processes and nonlinear dynamics. Its application to the study of financial markets has also been termed statistical finance referring to its roots in statistical physics.

In medicine, there are health economics, pharmacoeconomics and clinical economics to guide the most efficient allocation of scarce resources in this social subsector. In all these subsectors economic analyses are founded on the principle that choices must be made among alternative uses of limited resources, and thus decision making in the health care arena should consider both costs and health benefits (i.e. improvements in the health status of a target population). Clinical economic analyses are performed primarily to assess the health outcomes achieved with alternative health care interventions relative to the costs involved. The ultimate goal of clinical economic analysis is to maximize net health benefits for all persons in a target population given a range of health care interventions and known resource constraints.

Indeed, there is economics of everything conceivable including the economics of this lecture. As Levitt and Dubner (2006) rightly observed “economics is a science of excellent tools for gaining answers to modern real world issues as opposed to a subject matter, then no subject, however offbeat, need be beyond its reach.” In other words, economics science is applicable to any socio-politico-economic issue – any real life issue.

Vice Chancellor, Sir, permit me to use the first person I. In 1976, using multivariate regression analysis in executing my undergraduate research project I showed what was happening and continuous perhaps till this moment, namely, the “Dutch Disease”, wherein oil activities even as at then has begun to crowd out the agricultural sector. Admittedly, at the end of the 30 months civil war, many variables could explain the decline in agricultural output. But, the trade-off between oil and agricultural activities was statistically convincing. However, it need not be so with astute policy engineering. Agreed, oil blow-outs and spills will pollute farm lands and impact negatively on agricultural activities. But, chemical fertilizers and agro-chemicals such as insecticides and pesticides – derivatives of oil petrochemicals – are powerful components of the Green Revolution.

I have heard people say, the Nigerian economy is a “voodoo economy”, it does not obey any known economic laws. But, is it in the economy or in the character and style of the players, who ignore the rules of the games; play rough before injury time and get red cards from the referees. For example, those who started with us, Malaysia had increased its fertiliser capacity by sixfold or more, we had lost even the little we had and are importing fertilisers worth more than \$2 billions (allAfrica.com: Nigeria/stories/200905071001.html) and food worth on average \$3 billion each year (Punch Editorial Board, Published: Sunday, 27 Dec 2009). Importing even what we have in abundance. The contradictions are obvious. The nagging issue of appropriate prices for petroleum products in the country can be neatly handled by retail margin modeling.

In 1981, as a graduate student at the University of Pittsburgh, I showed how using the economic surplus technique could more accurately measured the social profitability of public investment in cocoa research. In 1986, I

applied these tools to Nigerian investment in oil palm research taking a total programme perspective and could not understand why the oil palm industry was declining in Nigeria, while understanding perfectly, why Malaysia which took her first oil palm seeds from the Nigerian Institute of Oil Palm Research (NIFOR) had become the leading exporter of palm produce exporting more than a million tons of palm oil from which Nigeria was sourcing her palm produce to satisfy both industrial and domestic uses.

From the mid-1990s to 2003, when I went on leave abroad, I represented the Federal Government on a number of environmental impact assessment (EIA) panels on oil and gas projects. In those days, the oil companies will proudly talk about “community assistance”, which did not go down very well with the economists’ way of thinking. Applying the opportunity cost perspective, I arrived at ‘community development’ concept. Today, I am glad to find that community development, stakeholders and partnership concepts have become part of the lexicon of EIA studies in the oil and gas sector.

If the Supreme Court Judges had read my papers on “Fiscal Federalism”, (1999) and “Resource Control and ... the Market for National Union”, (2001), perhaps their judgement on the famous resource control suit would have been different. Of course, the resource control issue was settled politically, setting the court judgement aside as it were. In a paper with my darling wife on “Assets Portfolio” selection (1998), we showed when it is proper to diverse assets portfolio holdings beyond risk aversion. In 2006, I provided an alternative formula for the optimal provision of public goods and taxes required for catering for collective goods. In the same year, working with my coursemate and friend Professor Cole, we sharpened the methodology for handling tort issues in Forensic economics.

At the Botswana national think-tank, Botswana Institute for Development Policy Analysis (BIDPA), I infused economic theory into policy research, analysis and advice taking it beyond institutional analysis and the results are marvelous and convincing with practical utility. Using the economists' way of thinking, we showed how best to answer questions regarding agricultural subsidies; options about how best to use a national abattoir; how to unpack tenders to unleash the potentials of the indigenous economy of Botswana by promoting small, micro and medium enterprises (SMMEs) effortlessly that will in turn generate employment, income, and skills and competencies for accelerated growth and development, and hence poverty reduction through engineered incentive-based mentoring and learning. Applying the same principles, we showed how the informal sector can be harnessed into a growth pole and grafted onto the mainstream national economy for poverty reduction. The list can go on but the usefulness of economics science and the economists' way of thinking had been demonstrated amply.

The Constraints on Uses of Economic Science

First, economists publicly disagree with each other so often that they are easy targets for stand-up comedians. Yet non-economists may not realize that the disagreements are mostly over the details — the way in which the big picture is to be focused on the small screen. When it comes to broad economic theory, most economists agree (over 90%, Alston, R. M., et al., 1992). President Richard Nixon, defending deficit spending against the conservative charge that it was "Keynesian," is reported to have replied, "We're all Keynesians now." In fact, what he should have said is "We're all neoclassicals now, even the Keynesians," because what is taught to students, what is mainstream economics today, is neoclassical economics (see E. Roy Weintraub, *The Concise Encyclopedia of Economics*).

“If all economists were laid end to end, they would not reach a conclusion.” This quip from George Bernard Shaw is revealing. Economists as a group are often criticised for giving conflicting advice to policymakers. President Ronald Reagan once joked that if the game Trivial Pursuit were designed for economists, it would have 100 questions and 3,000 answers. Why do economists so often appear to give conflicting advice to policymakers and debate among themselves? There are two basic reasons:

Economists may disagree about the validity of alternative positive theories about how the world works, which is easy to understand since no one sees at 360°; each angle of observation gives a different perspective.

Economists may have different values and, therefore, different normative views about what policy should try to accomplish, which also is easy to understand as policies have differential distribution of benefits and costs.

In other words, economists disagree on the basis of differences in Scientific Judgments. Fortunately, this is not peculiar to economics alone. Several centuries ago, astronomers debated whether the earth or the sun was at the center of the solar system. More recently, meteorologists have debated whether the earth is experiencing global warming and, if so, why. Science is a search for understanding about the world around us. It is not surprising that as the search continues; scientists can disagree about the direction in which truth lies (see http://mankiwXtra.swlearning.com,_Chapter 2 Thinking Like an Economist).

Economists often disagree for the same reason. Economics is a young science, and there is still much to be learned. Economists sometimes disagree because they have different hunches about the validity of alternative theories, i.e. about how the world works or about the size of important parameters. Another important source of differences is differences in values that influence answers to many questions, in particular as economists are participant observers. For example, questions about equity have no final answers. Given the possibility of differences in scientific judgments and

values, some disagreement among economists is inevitable. For possibilities, debates and disagreement among economists are in fact functional fueling the Kuhnian anomalies that lead to scientific revolutions and progress. Thus, debate and disagree, economists must.

Economists' predictions are not exact, but they do have a method – a systematic way of thinking about the world that is truer than not, that gives them genuine even if imperfect expertise. Because it is a social science, economists have less control over their data than natural scientists. Though true, precision is improving in time. This is not to claim that the error term has become zero in economic equations or random shocks to real economies had vanished; but, because more data and more powerful tools from processing and analysing them had become available.

My Submission

Vice Chancellor, Sir, all other protocol duly observed my submission to us is that economics with all its infirmities, we shall stop studying and using this beautiful noble life-enhancing science prudentially and creatively at home, in the community, city, district, local government area, state, nation and the world at our own peril. For those studying economics be proud of yourselves for taking that bold step and you are urged to pursue it with vigour and excellence; for those intending, what are you waiting for? You have over 130 roles to play in industry, education, scientific public service and research organisations, self-employment, hospitals, and indeed in any department of human activity.

Surprisingly, economics is dismal not because it is dismal but only because Carlyle loved the continuation of slavery. It is bankrupt only because practitioners abuse its principles and methodologies. **At this point, I will categorically say that abuse does not invalidate use.**



Figure 14: I Rest My Case
Source: Ayogu (2009)

Mr. Vice Chancellor, Sir, and this wonderful august audience, I cannot thank you enough for your legendary presence and attention. Kealeboga! Thank you so very much.

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